UNITED STATES ARMY SEPTEMBER 1967

AVIATION DIGEST

UNITED STATES ARMY AVIATION DIGEST

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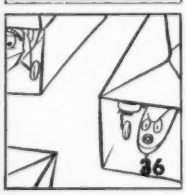

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The mission of the U. S. ARMY AVIATION DIGEST is to provide information of an operational or functional nature concerning safety and aircraft accident prevention, training, maintenance, operations, research and development, aviation medicine, and other related data.

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Articles, photos, and items of interest on Army Aviation are invited. *Direct communication is authorized to: Editor-in-Chief, U.S. Army Aviation Digest, Fort Rucker, Alabama.*

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LETTERS

Sir:

Not wanting to bring any discredit to as fine a fighting unit as the 173d Airborne Brigade, I would like to point out that the UH-1D pictured in June 67 issue of your magazine on page 62 is in reality an aircraft from my own unit the 173d Assault Helicopter Company, 11th Combat Aviation Battalion, 12th Combat Aviation Group, presently stationed at Lai Khe, RVN. The nickname on her door, "Sic 'em Puss," and the "Robin Hood" hat on her nose distinctly confirms the aircraft to me, and I'm sure all the members of the "Robin Hoods" of "Sherwood Forest." Thank you for showing her anyway. All the members of the 173d Assault Helicopter Company will be glad to see her.

SFC ELWOOD SERGENT
1st U. S. Army Flight Detachment
Ft George G. Meade, Md. 20755

• *Many thanks for your kind letter. The photograph in question was received with caption identifying the aircraft as being 173d Brigade. We regret the error.—The Editors*

Sir:

The uncomfortable realization that one may not be able to cope with any one of the multitude of emergency situations that might arise while flying a particular aircraft is the concern of many aviators today. Monthly safety meetings, safety bulletins, and posters can all be exposed to the aviator, explaining in detail recent accidents and the pilot's course of action during the emergency, yet that still "flyable" aviator will come away with the same uneasy feeling that in a very demanding emergency situation he might not be able to perform such maneuvers as autorotations or landings with antitorque failure with his current proficiency of emergency procedures. Why?

Because if he is not currently in an organization in which he, as an instructor pilot, is teaching basic emergency procedures, then the chances of his being able to take periodic proficiency rides to maintain his proficiency is very slim. With the current intensive training programs, massive buildups of aviation units stateside, and the tremendous scheduling of missions in Vietnam, aviation units are not able to maintain prescribed periodic proficiency ride programs.

Without a chance to research this area of Army aviation, it may be said that most aviators fly from four to seven months without a dual ride with an instructor pilot to update his proficiency. It has been the experience of some that to get a proficiency ride, they must maintain a constant vigil on the scheduling and operations officer for many weeks, then sometimes resort to pressure on higher authorities to secure such training flights. This is especially true in Vietnam where combat missions take precedence over training. If aviators are expected to fly 1,000 hours in Vietnam in rotary wing aircraft, then they must be allowed more frequent training opportunities.

If aviation safety is to increase, unit commanders should not leave this form of unit training responsibilities up to the individual aviators, but ensure a very definite training program incorporated into the daily, weekly, and monthly schedules.

CW2 CECIL O. GILL
Dept of Rotary Wing Training
Ft Rucker, Ala. 36360

• *USABAAR reviewed the above letter and made the following comments:*

The need for proficiency training in a combat environment is well recognized and so is the problem of conducting this training without detracting from the unit's primary mission. There is no regulatory solution to this problem; every unit has to establish a program that can be adjusted to its operational requirements.

The writer's impression that most aviators fly four to seven months without a dual ride may be based too much on personal experience, although we must admit, unfortunately, that the complaint is not an isolated case. On the other hand, we have the good examples of unit commanders who run an imaginative proficiency training program which provides the pilot, for instance, with autorotative practice every 90 days and a minimum of two hours hood time every 30 days.

We hope that the writer's letter will stimulate command awareness and initiative in this vitally important matter.

Sir:

Armed helicopter missions have expanded from the sole mission of escort of unarmed helicopters. Today armed helicopters are one of the best direct fire support weapons available to the ground commander. To accept the mission of direct fire support, the armed helicopter commander must know as much as, or more than, the ground commander about the ground battle.

This statement is a truism that unfortunately is not understood by many of the people concerned, both aviators and ground commanders. Until this statement becomes a part of the qualification for armed helicopter commanders, aerial fire support for ground units will not approach the degree that the helicopter weapons can provide.

Any armament trained aviator can provide fire at the point or area requested by the ground commander. In addition to firing weapons, the aviator must know and understand enemy capabilities and limitations. Knowing the limitations will allow the armed helicopter aviator to select the best attack to inflict the most damage with minimum exposure of the helicopter.

The versatility of the helicopter can and will allow the aviator a further chance to assist the ground unit. The aviator is in a far better position to see and observe the battle area. The ground commander has immediate knowledge of what he can see and hear; the aviator can see the whole battle area. He can, in many cases, determine enemy positions, strength, and disposition. He can see the friendly forces, avenues of approach and obstacles. He can see what courses of action are available to the ground forces and advise that commander on how he can best support an attack.

The armed helicopter commander sees these things in the course of battle and he must know the ground unit's capabilities so he can immediately reject inappropriate recommendations and offer only those recommendations feasible to the ground unit.

The armed helicopter commander cannot replace the ground commander. Armed helicopter direct fire support is an augmentation to increase the ground commander's capability to inflict damage on the enemy. The armed helicopter must be an integrated part of his resources. All final decisions rest with the ground commander. As a member

Continued on page 64

The Army's increasing requirements for aviation medical officers in the early 1960s at Ft Rucker, Ala., resulted in establishment of the Department of

Aeromedical Education & Training

Colonel Richard B. Austin, III

ARMY AVIATION medicine came into being under the leadership of MAJ Theodore C. Lyster, MC, USA. He was the first Chief Surgeon of the Aviation Section, Signal Corps, United States Army, during World War I. As a result of his work, methods for selection of aviators and physical standards which they were required to meet were established. He has become known as "The Father of Aviation Medicine."

On 18 February 1967 a fitting memorial to Brigadier General Lyster, Lyster Army Hospital, Fort Rucker, Ala., was dedicated with The Surgeon General, LG Leonard D. Heaton, as the principal speaker. This fine hospital is the first in the Army to be built with specific facilities for the care of aviation personnel planned from the beginning.

Army aviation has rapidly progressed since World War II; however, progress in the field of Army aviation medicine lagged greatly behind until 1950. LTC Rollie H. Harrison at that time was the only Army flight surgeon. He developed the first aviation medicine program at Fort Sill, Okla., and was soon noted for his contributions to medical care of aviation personnel. He also acted as advisor to the Director, Department of Air Training regarding medical problems of aviation.

After the Aviation School moved from Fort Sill to Camp Rucker in 1954, COL William H. Byrne soon succeeded LTC Harrison as the Staff Aviation Medical Officer. His contributions to aviation safety included attempts to regulate maximum individual flying hours in an effort to reduce physical and mental fatigue among aviators.

During the period 1950-1963 the Army depended on the Air Force and Navy to train its aviation medical officers. The expansion of Army aviation to meet requirements in Vietnam had a dramatic influence on aviation medicine training. In 1963 it rapidly became apparent that the Army's requirements for aviation medical officers could not be met by the quotas for training spaces offered by our sister services. As a result of these requirements the Department of Aeromedical Education and Training (DAET), U. S. Army Aviation School, was established at Fort Rucker on 1 May 1964. COL Spurgeon H. Neel, Jr., was appointed the first director of the department. He was succeeded in August 1964 by the author, who currently holds this position.

COL Austin is CO, Lyster Army Hospital and Director, Dept of Aeromedical Education & Training, Ft Rucker, Ala.

DAET functions in an advisory capacity to the commandant of USAAVNS on all aeromedical problems. Its mission involves the conduct, planning, supervision and coordination of aeromedical education and training within the Army Aviation School.

This department is primarily concerned with the organization and conduct of the Army Flight Surgeon Training Program. The Basic Army Aviation Medical Officers' Course is a five week course offered to Medical Corps officers with no previous training in aviation medicine. At the conclusion of this course they become aviation medical officers, and most of them are ordered to Vietnam to care for aviation personnel assigned to aviation units in combat.

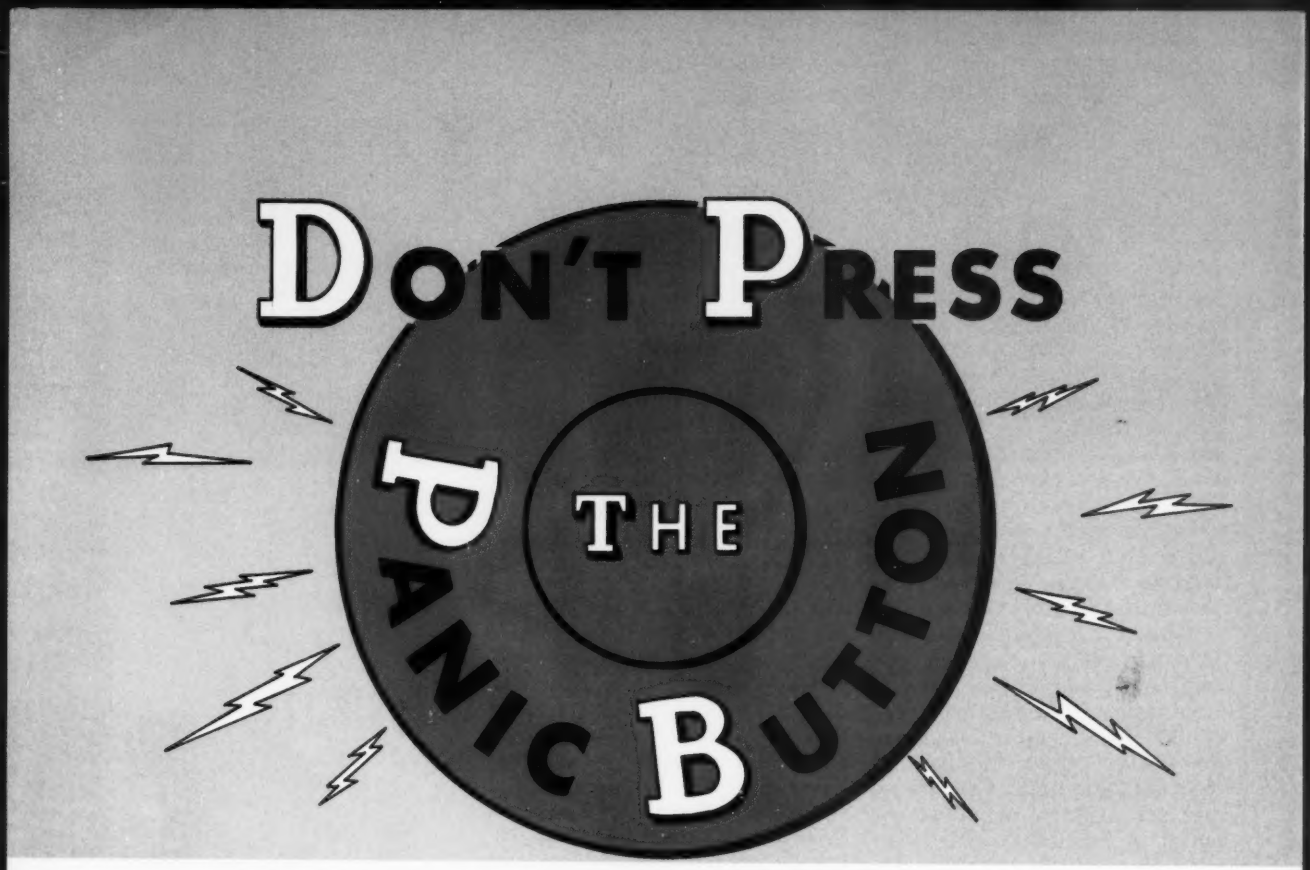
The Army Aviation Medical Officers' Orientation Course is given to Medical Corps officers who have recently completed either the Navy or Air Force Flight Surgeon's Course. This two week course is specifically designed to point out some of the medical problems among aviators in the Army.

The Senior AMEDS Officers' Aviation Orientation Course is given to nonaviation AMEDS officers (MC, DC, ANC, and MSC) and is designed to acquaint senior officers who will assume command positions in units with large Army aviation contingents with some of the peculiar medical problems with which they will be faced. No new MOS is given in this course.

Of considerable interest to Army aviators is the aeromedical consultation/inflight evaluation service operated by DAET. Through this service an Army aviator with a medical suspension from flying duties as a result of an accident or combat incurred injuries may be considered for return to flight status if his condition is stable and not considered a hazard to flight safety. The inflight evaluation portion of this service was established at the USAAVNS by AR 600-108 on 31 May 1966. Requests for evaluation are initiated by local flight surgeons through medical channels. If the request is approved by OTSG and OPO the aviator is ordered to the Army Aviation Center for the aeromedical consultation/inflight evaluation. The results of this evaluation are then forwarded to The Surgeon General's Office with the recommendation of a board of flight surgeons. To date approximately 40 medically incapacitated aviators have been evaluated, and the majority of them have been returned to flight status with varying restrictions.

Future plans of the Department of Aeromedical Education and Training include development of an aeromedical specialist course with a new MOS. This course is being planned for fiscal year 1968. The course will be oriented toward acquainting enlisted personnel with some of the medical problems peculiar to aviators, and they will receive instruction in assisting the flight surgeon with the flight physical. The course will also deal with administrative procedures involved in medically restricting aviators and returning them to flight status. These medical soldiers will also receive training in aeromedical evacuation. The prerequisites of this course will be advanced individual medical training and experience as a medical soldier.

The Department of Aeromedical Education and Training is primarily concerned with the organization and conduct of the Army Flight Surgeon Training Program



Captain James P. Goldschmidt

NOVEMBER, but no snow on the ground. Thanksgiving is just around the corner, and I'm thinking of a turkey dinner. Won't be quite like Mom's, but the mess sergeant will do his best, I know. A glance at my watch tells me it's 0800, that we've been here at Dau Tieng an hour already, and still nobody knows whether parts of the 1st Division will be lifted out or reinforced. One battalion is still in a fierce firefight.

"We need three ships for medevac!" pierces the morning's stillness.

My platoon leader tells me to crank up and follow him. That battalion in contact has some wounded; we're going to bring them in. I'll be number two with a 1st platoon slick behind me.

We're airborne now, and we've got radio contact. I'm on tactical FM and the situation sounds hot. "Grunts" are pinned down. Unit UHF is quiet after initial check-in, but Danger 77 is on guard, telling us that he's overhead and available to assist. Six minutes out now, halfway there, and we're told to return to Dau Tieng to pick up badly needed ammunition and bring it in. It's in slings for fast deployment. Platoon leader doesn't answer. Maybe he didn't hear the call. I call him, tell him about ammo. He says his FM is weak and getting weaker. Great! All we need now are radio problems!

We return to Dau Tieng and I become lead ship, since I know where the ammo is to be picked up and the platoon leader does not. He's going to follow me, now. My FM works; his doesn't.

As we hover up to the spot, I notice that it's all ready for us. Even have a "hook-up" man so my gunner won't have to dis-

CPT Goldschmidt is Assistant Operations Officer, Flight Division, USAPHS, Ft Wolters, Texas.

mount. Hooked up now, and I begin to ascend slowly to get the strap taut. Good grief, I'm at treetop level and it just now is tightening up. Must be 60 to 70 feet of sling strap. No ground cushion, and no wind. Well, here goes.

6400 . . . 6200 . . . 6000 . . . beep, beep, beep! Abort. Looks like a heavy one—and 1,000 pounds of fuel doesn't help, either. Let's try again.

6400 . . . 6200 . . . 6000 . . . beep . . . 5800 . . . beep, beep . . . 5700 . . . translational lift . . . lower the nose just a bit . . . airspeed coming up to 35 knots. Looks like we made it.

Climbed out at 50 knots and 6200 rpm. Upon reaching 1,500 AGL (above ground level), we proceeded toward the beleaguered battalion and their hunk of real "hot" jungle. My radio call on FM tells them we're coming, to get the WIA ready, that we'll take them out after dropping the ammo. The reply is to forget the WIA as the grunts can't get to them, to just bring in the ammo. I overhear a platoon leader tell the battalion CO that two VC machineguns to their front have them pinned down. Nobody tells me which way is "front."

Hang on; here we go. Great Scott, look at that LZ: 100-foot tall "snags," elephant grass and bullets. Sling is holding me back. Descending at about 700 fpm and 60 knots instead of the usual 2,000 fpm and 80 knots. Getting closer. Grunts *are* pinned down. One-hundred feet above the ground and I can't find a good hole. Let's look right and . . . WHAM!

It was a .30 cal round from an automatic weapon, but my head felt as though someone had hit me with a baseball bat above the ear. It knocked my head so hard that my ear bounced off my shoulder. The aircraft had received numerous hits, and had yawed since I most probably kicked out with my feet. However, it yawed not as far as it could have because my copilot was on the controls with me, as I had instructed him to be, before starting our descent.

"Is it off?" I yelled to the crewchief while squeezing the sling release button as often and as hard as I could. "Yes," was the hurried response.

The sling was dropped from about 50 feet above the ground, and I sure hope it didn't land on someone. My copilot and I pulled pitch and began to fly out over the jungle. We had no hydraulics, as they had failed immediately upon receiving the hits; and the loudest screaming, grinding noise that I've heard was coming from the engine area.

I knew I was hit in the head, but not how badly. The crewchief yelled over my shoulder that the gunner was hit in the neck. I could see four holes in my windscreen. I knew we were in bad shape. No servos, no radios, no intercom, and a loud grinding whine in the engine area. I quickly recycled the hydraulic switch, but placed it in the off position to prevent a surge, since there was no indication of servo assist.

My biggest fear now was an engine failure. I made a left turn and headed for an open area about 1/2 mile from the fighting. We made a poor approach—somewhere between the school solution and a combat dive, but we got it down with zero groundspeed, no bouncing, and no damage to skids.

Upon landing, the grinding noise stopped. I got full rpm out of the engine, and decided that getting myself and my gunner to a hospital quickly was worth the gamble of an engine failure with no servo assist. We pulled pitch, climbed out over a 75-foot barrier, and began the 8-minute flight to the hospital at Tay Ninh.

It wasn't until I gave the controls completely to the copilot that I even realized I had taken a

The impact bounced my head off my shoulder

The crewchief yelled that the gunner was hit in the neck

round through the left arm above the elbow, and had another embedded in my left thigh.

With proper control applications, we made a second zero groundspeed touchdown, this time at the hospital pad. We shut down and my gunner and I received immediate first aid and were placed in line to be med-evaced to Saigon. The last thing I asked before going to Saigon was for someone to ship my helmet home with my belongings. It has a small entrance hole in the shield above the left eye and a large one in back.

I received word later that the ship had over 50 holes in it, and nobody knows what kept it in the air. I guess we were real lucky. I shouldn't be grounded more than 12 months or so, and the gunner has already returned to duty.

We were lucky. That sling load was about 500 pounds too heavy for the ship, and the sling itself was approximately 50 feet too long. It put us at a real disadvantage from a maneuverability standpoint for a combat operation.

The loss of the servo assist could have proved a bigger problem than it was. I believe that my confidence in our ability to fly the aircraft and make two zero groundspeed landings and one confined area takeoff with no servos stemmed from a demonstration and practiced exercise given to and executed by me when under the control of a school IP in a training situation. I do not condone the flagrant violation of rules by performing unauthorized flight maneuvers, but I do feel that one such "violation" and demonstration in a servos-off configuration contributed to the saving of lives and equipment.

When the platoon leader's FM radio failed, I was moved into lead position, and that is no time to press the panic button. I had to make a decision as to go or not go when I first attempted to pick up the sling load of badly needed ammunition. I decided that the need overweighed the risk.

When my ship was hit, we lost all intercom capability, all FM, and my copilot could neither transmit nor receive, while I was able to do both on guard. Voice communication inside the ship was accomplished by yelling at one another, and was difficult to say the least.

Nobody aboard Robin Hood 593 pressed a panic button. Common sense, training, and coolheadedness prevailed among the crew—and this spelled the difference, I'm sure.

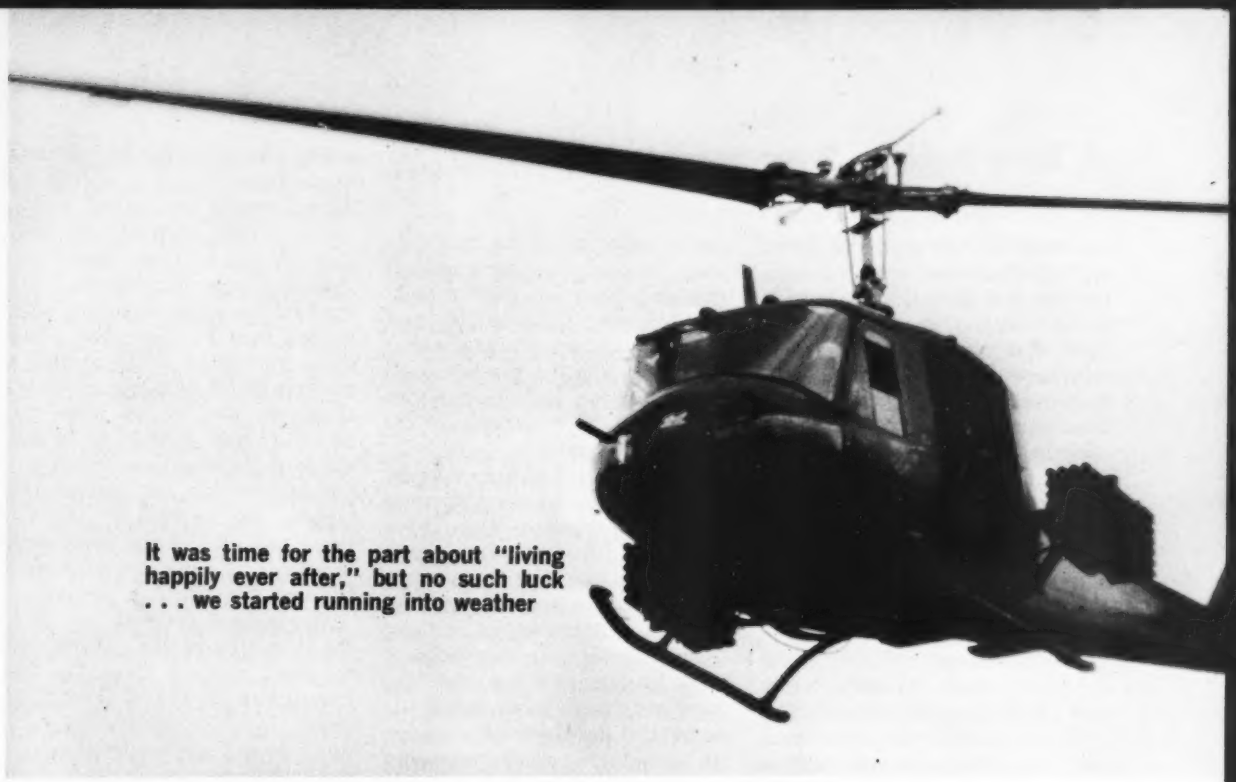
FOUR IN A ROW

EARLY THIS year 8th U. S. Army became the first major Army command to receive the National Safety Council's "Award of Honor" four consecutive years by winning it again for fiscal year 1966.

The award acknowledges the high standards maintained in 8th Army's overall safety program, outstanding reductions in the number of injuries and fatalities and the resulting savings in total accident costs.

This award winning command has also received the U. S. Army Pacific Award four consecutive years and the Department of the Army Award of Honor twice in the past four years.

After receiving all three awards during FY 65, 8th Army's safety program reduced U. S. Army personnel injuries 8 percent, other personal injuries 24 percent, Army motor vehicle accidents 11 percent, Army motor vehicle fatalities 26 percent, and Army aircraft accidents 11 percent.



It was time for the part about "living happily ever after," but no such luck . . . we started running into weather

A Rewarding Personal Experience

CW3 Max H. Bentley

BOY, WAS I sawing logs! It was a very good time for it—0300 and the rainy season at that! But remember what Sherman said about war! My platoon leader dragged me out of bed, and when he mentioned "mission" this definitely woke me up.

All of us concerned with the mission scrambled over to the command post and tried to find some coffee while our platoon leader was getting the mission briefing organized.

While waiting there I was slipping into retrospect, trying to stay alert. A sizeable force of our airborne troops was on a road clearing operation in the area and our company had been providing Huey support both in reconnaissance and fire support missions. I had certainly been glad to see these experienced American troops moving into the area. They had already been in Vietnam several months and "Charlie" was fast getting out of their pathway as they progressed.

I felt a deep pride whenever we flew support to these guys because they operated like real pro's. None of this tearing down the road with trucks full of troops; these people were scouting ahead every bit of the way. They had learned a lot about Charlie and his ambushes! However, anyone who has been to Vietnam knows that Charlie isn't dumb by any means. He gets out of your way until he can have the advantage of bad weather, darkness, good natural cover, or you name it.

When the briefing began I realized Charlie had had a perfect setup for what had taken place earlier this morning.

"We have three critically injured Americans to be evacuated to Nha Trang," the briefing officer began. As he continued, we learned that Charlie had sneaked into one of the forward areas and

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CW3 Bentley is a flight instructor, Advanced Instrument Flight Division, Dept of Rotary Wing Training, Ft Rucker, Ala.

A Rewarding Personal Experience

had tossed a few grenades. Most of them had done little damage; but one had landed either inside or just outside the small shelter some of our troops were trying to rest in, and these three men had been hurt badly. One had a severe head wound, one had a sucking chest wound, and the other had a badly injured leg. There had already been some delay, naturally, in trying to transport these men some distance to the compound where we were based, so we all had to do a lot of quick planning for their immediate evacuation.

No instrument capable "slick" helicopter was available. Only our gunships were left, and they were all loaded for a last-minute fire support mission. Getting a fixed wing ship into the nearby airfield was simply asking too much because the ragged fog and drizzling rain and an "educated guess" ceiling of 100 to 200 feet made it impossible. A Caribou did come, in spite of conditions, and made an attempt to get in while we were getting set to go. He called us and agreed to meet us on the ramp at Qui Nhon (about an hour away for us) with his engines running, to transfer the injured to his ship and take off immediately for Nha Trang where the best medical help could be had. That took care of that end of the mission. Now back to our part.

My gunship had the flex gun system with attached rocket firing pods and would take quite a bit of time to dearm; and time was something we just couldn't spare, so we headed on for our "Hog." She was a good, strong-powered ship. Even though I hadn't flown this one much lately, I knew the crew took loving care of her and I could trust her to get us there. There was a matter of getting this one unloaded of all the extras we could remove, plus dearming and removing the heavy load of rockets. Everyone pitched in and started to work on getting the ship prepared while the platoon leader, my copilot, and I set about getting the final details of the flight worked out.

The two of us had been selected for the mission because we were the only instrument pilots available (at this time instrument rated pilots in Vietnam were very few). My copilot was not too long out of instrument school and had not had the opportunity to build much experience flying actual instruments, but he more than made up for this part by his knowledge of procedures, good judgment, and a very smooth control touch. I was going on my 15th year in this business, but I must concede to having had a few butterflies in my stomach, which I am sure I blamed on that lousy coffee!

We agreed that the fast way, if you call 80 knots fast, to get there was to go on a direct course, even if it meant flying over rough mountainous terrain. The plan would include an instrument takeoff to the west and climbing on this heading to 7,000 feet before heading back southeast over the mountains east of us. This would give us good terrain clearance, a chance to tune in the automatic direction finder station at our destination, and last, but not least, a good chance to be picked up on the Air Force radar for vectors to Qui Nhon. There was a possible ADF approach waiting at Qui Nhon, but it was their dry season and ceilings should remain above minimums.

We had our maps and approach plates, so we headed back to the "Hog," which by this time was ready to go. Everybody had done a fine job preparing the aircraft to go, even including setting up three litters for the injured troops.

The vehicle soon arrived with the injured and we put them aboard as soon as possible. They were in bad shape; I didn't have to be a medic to see that. Since there were three of them and a medical officer who needed to go along, we decided to leave the crewchief and gunner to lighten the load. As soon as everyone was out of the way, we started the engine and hovered to the extreme east end of the compound to give us as much clearance over the trees on takeoff as possible.

Our takeoff worked out fine; the Hog climbed like a charm and we went into the soup. We followed our plan and leveled at 7,000 feet, crosschecking each other for fully operational equipment, correct course, and both wiped a little sweat for good measure!

Radar Assist came through and gave us course corrections and distances remaining to within sight of our destination. This made navigation easy, so that all we had to do was fly instruments and work the radios to get there.

Unfortunately, the man with the head wound didn't make it; he had lost so much blood even before takeoff that he didn't have much chance for survival. The medical officer did everything he could to save this man, but the hemorrhaging couldn't be stopped.

The weather broke up over Qui Nhon before our arrival, so we made a VFR approach and landed close to our Caribou friend, who had his engines running after hearing our call to the tower.

Everyone helped get the wounded moved into the Caribou and they took off immediately for Nha Trang. We parked our faithful Hog for refueling, and both breathed a sigh of relief that our former passengers would be in a

We both wiped a little sweat

good hospital in a short time.

After some food and rest and filing our plan at operations, we fired up our Hog and headed for home at "Poppa Kilo." The weather had been running pretty good when we started but as we were nearing the Mang Yang Pass, things weren't looking too conducive to remaining VFR for the other side of the pass. At this time it still wasn't a good idea to get within small arms range of the peaks while traversing the pass. So we diverted to the An Khe area and landed for more fuel and a bit of waiting for the weather situation to improve.

The best that our weatherman could promise was a wait of about two hours before the Poppa Kilo area would improve. Incidentally, for people who haven't flown this area during the rainy season, there is somewhat of a weather boundary between the dry season on the coast and the rainy season in the Central Highlands. The An Khe area sometimes becomes this boundary with weather that is broken to scattered. With the rise in ground level, the ceiling will get progressively lower on up into the Mang Yang Pass, with accompanying shower activity which cuts down your forward visibility in helicopters considerably, making it difficult to get through.

I contacted our operations, giving them the expected delay, and my copilot looked up some old friends, since this was his old outfit from stateside.

After the delay we fired up the old ship and headed on through Mang Yang Pass. This is the time for "They lived happily ever after," but no such luck! After the pass we started running into some weather, but we had good contact with approach control radar, and since they weren't crowded with other traffic we decided to go on top and do an approach on arrival at the ADF at destination. We ended up at 10,000 feet over Poppa Kilo and held over the area until they could bring us on down via a radar directed approach.

We had decided to do the radar approach instead of the ADF because approach control could do a much greater job of keeping us out of the way of C-130s coming into the nearby Air Force facility.

In approximately 10 minutes approach control started vectoring us down in a big rectangular pattern. We went actual instruments at 8,000 feet indicated altitude and kept following radar vectors down to normal ground controlled approach altitude. We were handed off to GCA and continued the approach until our airstrip showed through the rain and overcast at 1/2 mile and 250 feet of altitude.

We eventually got back our crewchief and gunner from the original departure point, and our Hog was ready to go in a short time!

In summary: The above story is true and, I believe, proves once more that good instrument flight training pays—in this case with two lives saved and a rewarding personal experience.

Minigun Production Boosted

The U. S. Army has granted General Electric two letter contracts for continued production of the 6,000 shot-per-minute, 7.62 mm minigun, minigun pod and spare parts. At left, an assembler makes final adjustments on one of the weapons at General Electric's armament department in Burlington, Vt. The minigun is being used on Army helicopters in Vietnam (see "The Year of the Mini," DIGEST, May 1967). High rates of fire are made possible by using a rotating cluster of six barrels and a high-speed, linkless feed system. Each barrel fires only once every six shots, resulting in low maintenance and high reliability.

I learned about fronts from that (cat?)

Captain Eddie M. Beasley

IT WAS August 1961. I departed Henry Post Army Airfield, Fort Sill, Okla., at approximately 1400 hours. Destination: Tradewinds Airport, Amarillo, Texas. Purpose: weekend pleasure trip. Credentials: 60 hours total flying time and a private ticket earned at Redleg Flying Club, Fort Sill. Equipment: a PA-18 Super Cub (L-21 to you old-timers), 05 + 30 fuel, basic panel and VHF–3 omni. Passengers and equipment: a two-month-old kitten, in box with airholes, strapped in the rear seat, toothbrush and change of clothing. Herr Kitten was to be a gift to the children of acquaintances in Amarillo.

I lined my trusty little aircraft up with sod 13L, added power, and was merrily on my way. At altitude, I noticed the summer cumuliform and light turbulence which had been forecast; no problem. Over Clarendon, Texas, I noticed that the cumuliform were getting more frequent. I cracked the volume on my omni. It was about 42 after the hour and I just might be able to get Amarillo's weather on the 45 weather report.

"Amarillo, scattered cumuliform, winds SW 15 knots, steady, altimeter 29.82. Pilot reports light to moderate turbulence west, southwest, Cessna 310. Quasi stationary front lies along Texas, New Mexico line from Dalhart to Clovis, N. M.; occasional lightning observed to the west."

These weather people and their $1.98 words! I'm not sure about this "quasi" bit, but I thought I knew what stationary meant—no problem, continue to march!

Over Claude, Texas, I can now clearly see this "quasi" something or other front to the west. Looks like the tops might be at—oh—about 50,000 feet. Sure glad I'm not going any farther west than Amarillo.

It's now about 1710, and it seems to be getting dark earlier than usual. I'd better turn my running lights on. That's odd; I can see Amarillo Air Force Base and the beacon from Tradewinds southwest of the air base. Sure seems early to have the beacon on at Tradewinds. I'd better call Amarillo Flight Service and find out what's going on! Now that was sure a waste of time! They gave me about the same report as was given over the omni an hour and a half ago.

I can now clearly see Amarillo, Tradewinds, and the Air Force Base. Wait a minute; where did Amarillo go? I don't see Tradewinds either! Now the Air Base is rapidly disappearing. I'd better get there in a hurry. Now I don't see anything but my running lights, and I can hardly see them —the ground has disappeared. Now what did my instructor tell me about this situation? Oh yeah, make a 180, keep that little ball centered, put the left edge of the needle on the right side of the doghouse.—I wish that cat would shut up. It isn't that turbulent!—How about that? Worked like a charm; flew right back out of it!

"Piper 6478 Delta, this is Amarillo radio. Over."

"Amarillo this is 78D. Go ahead."

"Roger. Be advised that Amarillo has gone IFR, prefrontal squall. What are your intentions? Over."

What kind of nonsense is this—prefrontal squall, IFR? What are my intentions? This guy must be some kind of nut. My intentions are to land—somewhere!

"Amarillo, this is 78D. Where is the nearest field with night lighting and VFR conditions? Over."

"Roger. Suggest Plainview, Texas, 65 miles south on the 180° radial of the Amarillo VOR. Over."

"This is 78D. Extend my flight plan one hour and change my destination to Plainview." — Sure wish that cat would shut up back there.

Over Canyon, Texas (15 miles south of Amarillo) and the omni needle is beginning to come in on the 180° radial. Well, I'll be darn! I can see the four-lane highway between Amarillo and Canyon, and there is Tradewinds. I'll just fly up the highway, jump into the pattern at Tradewinds, and land. What a bunch of nuts these weather/flight service types are! They haven't been right yet.

So far so good. Now for the 45° entry leg to downwind. Amarillo sure looks good! Should be down in about 5 minutes. Not again! The city lights have again disappeared. The altimeter is winding up like a Z watch. Full power, stick full forward, the altimeter is still winding, rapidly. — There goes that cat again! — Make a turn back to the south; maintain a general heading of south. Now the turbulence is moderate to

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CPT Beasley was an instructor in the Academic & Synthetic Trainer Division, Dept of Fixed Wing Training, Ft Rucker, Ala., when he wrote this article.

. . . turbulence is moderate to severe and aircraft control is questionable! That cat has torn himself a hole in the box. He is on the ceiling, on my back, on my hat, his claws sure do smart

severe and aircraft control is questionable! — That cat has torn himself a hole in the box. Now he is on the ceiling, between my legs, on my back, his claws sure do smart. Now he's back in the baggage compartment; he is on the ceiling again! — I must be inverted. The altimeter reads 12,800 feet and climbing; control is almost impossible, heading is questionable, and the magnetic compass looks like a yo-yo. I'm through 16,000 feet indicated. Things just don't seem to matter anymore. I feel pretty good. — If I could get my hands on that cat though, I'd kill him!

The turbulence suddenly stopped. Now it is perfectly calm. The instruments are settling down and I can see for tremendous distances. That looks like Plainview about 50 miles south and beyond it at about 100 miles, Lubbock. The altimeter reads 17,800 feet. I feel just fine, but still realize than 17,800 feet is just a little high.

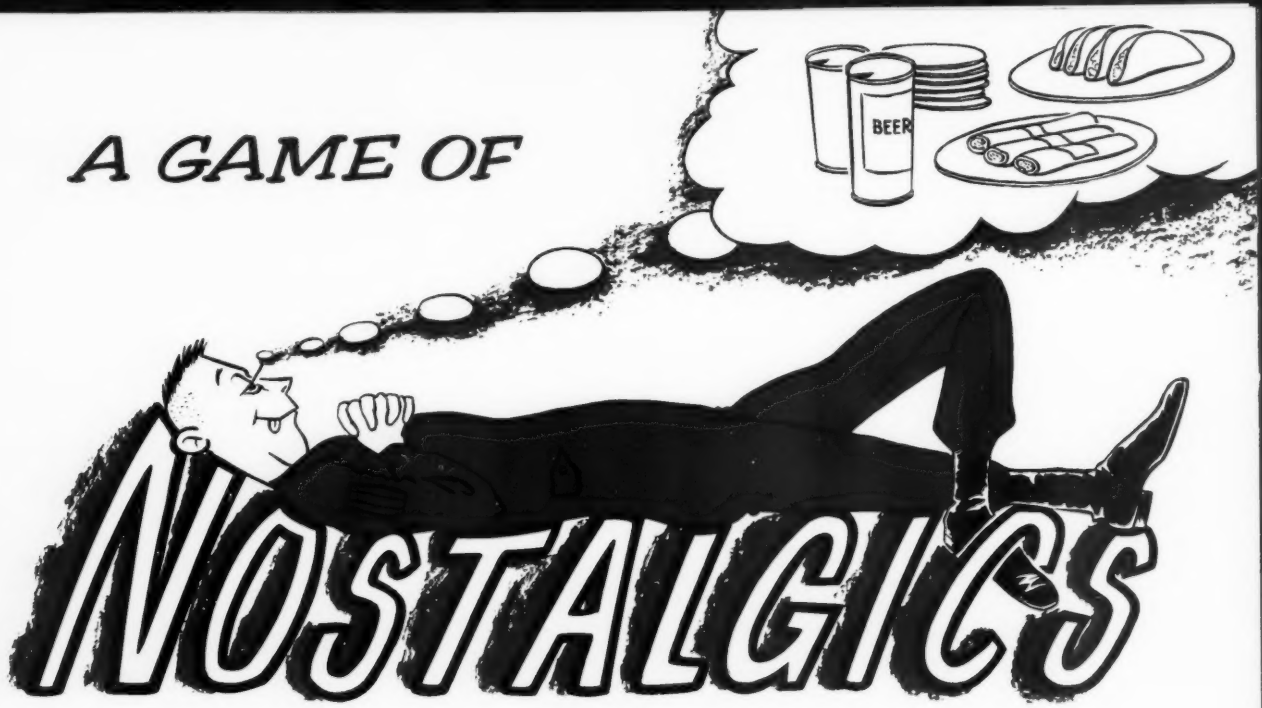
Now at 8,000 feet, I have a splitting headache but am otherwise OK. The aircraft seems, miraculously enough, to be operating normally. The cat is now in the baggage compartment, apparently hung up in the first aid equipment. Good enough! That will keep him off my back. I sure wish he would cut out the noise though.

On final at Plainview, the lights of both the city and the active runway were beautiful. Never again shall I encounter a sight more gratifying or breathtaking! After landing and engine shutdown, I suddenly realized that I was extremely tired. I also realized that what I had encountered, few men live to talk or write about. I also counselled myself that I would make it my business to prosper from the many gross errors and stupid mistakes I made that night.

In reading this, I'm sure my errors are obvious enough to you. For this reason I'll not summarize them. However, if there is any question in your mind about my respect for weather, I'll be glad to talk with you. You see, I teach weather — and I might add, I volunteered for the assignment.

Incidentally, after landing, I untangled the cat from the first aid equipment. He bit me, I turned him loose, and last saw him racing across the field at full speed. I turned to ask the attendant if he had a hose and water available. I had an airplane to clean up.

A GAME OF NOSTALGICS



Major "Rip" Cord

Panic struck! Rumination of the flight had led me to the irrevocable conclusion that I had not checked the BOOK —I had not even *seen* the BOOK!

LET'S PLAY a little game. We'll call it "Nostalgics," or "Has this ever happened to you?" Go directly to jail, do not pass "go," do not collect $200. Well now, let's play a more serious game—has this ever happened to you?

One day not so long ago, it came to my attention that I required some flight time to make up my allotted number of hours for the month. Anyway, I was tired of flying this desk—this square, brown machine that I fly 99 percent of the time. Having no place in particular to go, I indicated (to the folks at unit flight operations) my availability for a soft-touch mission.

Yes, there was a requirement to wing it over to Plum Point Marine Corps Air Station to deliver a load of cargo and two officers. As it turned out, the officers were ground pounding friends of mine. One was a college classmate, the other an acquaintance; so I really wanted to impress them with my Steve Canyon capabilities.

The sky was a brilliant sunny blue, and the weather was warm for October. In other words, it was a thoroughly beautiful field grade day to be out of the office and in the arms of this friendly, southern sky. With spirits soaring and my mind fixed on a fabulous Mexican dinner we were to have that night, I sauntered to base operations and filled out my 175, checked the NOTAMs, and got the weather, which was violently VFR-CAVU all the way.

I made a ho-hum effort to find a sectional to go along with my en route low altitude navigation chart—mainly because I had never been to Plum Point and I wanted to peruse the lay of the land. Anyway, all the nav radios might go out, and then I would need a sectional. I did not find one. The flight planning room was undergoing its umpteenth redecoration/reorganization, SOP for Good Ole Army Airfield; therefore, the charts were in someone's trunk or other handy place.

Well, no matter, the navigational chart would get me there. If necessary, I could fly directly east, turn right at the ocean, and proceed down the beach—too bad it was October—to Plum Point. Having checked the weather, I got my 175 proofread by the WAC at the operations counter and was sent on my way with a cheery, "Have a good flight, sir."

I approached the airplane with a certain jaunty, carefree attitude, trying to look terribly nonchalant and at the same time seriously professional—somewhat like "Snoopy" preparing to go out in his Sopwith Camel to gun down the "Red Baron." With an air of nonchalance, fraught with displays of

studied grace and care, I conducted my external preflight inspection, wheeling about the aircraft looking as if I knew what I was looking for.

I made sure that all was fastened down, ushered my passengers to their places, and explained that the "smoking lamp" was out—a little touch of the nautical to add to the impressive picture I was developing for my audience. I saw to it that the passengers were made as comfortable as possible and instructed the fellow in the copilot's seat on how to operate his headset so we could make light conversation. Now let's see. I checked the cargo and saw to it that it was properly secure; made my rounds about the aircraft, scrutinizing all the salient points which I could remember from the -10; and made sure that my passengers were properly tied down.

I checked the panel in a competent clockwise sweep, checked the circuit breakers, saw to it that the main gas switch was to the on position and made elaborate motions to start the engine. A press of the switch and the aircraft coughed and barked to life. We received instructions to the runway where I carefully went though the preflight runup, gained permission for takeoff, taxied onto the runway, aligned the gyro compass, checked all engine instruments in the green, and blasted off into the blue.

I informed my passengers that the stewardess would not be available on this flight and that the martinis had been left at base operations—light banter to put my passengers at ease. My eyes scanned the instruments for possible trouble.

As we cruised smoothly along, my mind was dancing with thoughts of enchiladas, tortillas, refritos, frosty cold beer, and rousing good company awaiting my return home. My mind then wandered back to the flight, and I began mentally tallying up the score to this point in time and space. Then it happened. Panic struck!

Although my life didn't flash past, my mind's eye caught a glimpse of the untimely demise of my flight career which, of course, piled panic on top of panic. Outwardly, I remained as unruffled as the proverbial duck. Rumination of the flight had led me to the irrevocable conclusion that I had not checked the BOOK—I had not even seen the BOOK!

Furtive glances were made in an attempt to find that little green devil. Surely, it was under the seat or in the back. Finally, I enlisted my passengers to form a posse. The inside of the airplane looked like an A-GO-GO party in a phone booth. Alas, to no avail. I called off the search with a shrug and indicated everything was A-OK (this so as not to alarm my now rumpled, sweating strap-hangers).

My eyes scanned the instrument panel. All the engine instruments were calm and in the green. Better yet, the airplane wasn't doing anything unusual. But—what was the status of the airplane? I started to rationalize myself out of it. Well, I mused, they wouldn't have assigned me the aircraft if it weren't ready. No? That's no good. How many times, you big dope, have you found a red X during preflight? Plenty! Well, they certainly wouldn't have loaded the cargo on board if the ship weren't ready! Ha!

Everything looked all right—everything looks all right now. Wait, what's that funny noise—just my imagination? A missing engine? A runaway prop? Maybe the horizontal stabilizer is falling off! I guess I had better turn around. No! It's closer to Plum Point. OK, cross fingers and plow blindly on. Surely everything is all right!

Thoughts of enchiladas, tortillas, and refritos left my mind. But did I ever want that cold beer! The nonchalance of being an "old pro," newly appointed senior aviator left my mind. There I was stranded in the blue with two passengers, a load of cargo, a relatively expensive airplane, and I hadn't even checked the BOOK—gad!

We finally landed after what seemed to be an interminable flight. Actually, it was all of 45 minutes. I got out, gave the old airplane a fraternal pat, and sent the passengers and cargo on their way. Heaving a sigh that we had gotten there safely, I sauntered over to base operations and casually asked for the telephone to call SCAN—to Good Ole Army Airfield. I finally got the crew-chief on the line and confirmed that the BOOK was, indeed, back at the base. There were no red X's or diagonals; everything had been signed off and the aircraft was, in fact, ready to go.

With a feeling of immeasurable relief, I climbed back in my trusty steed, took wing, and headed for the haven of home. When I landed, out came the crewchief wearing a wide grin—you know the kind—with that little green book in his hand. He put the icing on the cake when he said, "No sweat, sir. At least you didn't crash." I registered my flight time, the fact that the flight was OK, signed off the BOOK, and beat a hasty retreat to warm, waiting wifely arms and that cold beer.

Has this ever happened to you? Why don't you play a game of "Nostalgics" and see what may have happened or could happen to you. It is a deadly serious game, and if you don't look at all aspects of it, you may find that you will go "directly to jail, and not pass go, and not collect $200!"

Defense Against Airmobile Operations

Major Howard A. Kendall

THESE IDEAS for a defense against an airmobile attack began to grow in Vietnam where I flew both the CV-2B airplane and the UH-1B armed helicopter. It was apparent that our aerial suppressive fire was more effective than an equal volume from ground positions. I attribute this to the Viet Cong's fear of unknown weapons and tactics, or a result of their experience with the massive destruction of conventional air support. The real reason is unnecessary to this study, and is included only to show that suppressive fire is necessary to reduce the accuracy of ground fire.

Another observation was the extreme inaccuracy of ground fire. Even tracer fire was poorly adjusted. In conversation with our own ground personnel, I discovered that a majority of them had erroneous ideas of the principles employed in firing at moving targets. They also did not understand how to use tracer ammunition.

Our potential enemy in large-scale land warfare is known to possess airmobile capabilities which equal or exceed our own. As early as 1956, the USSR was a pioneer in helicopter development, and held world records for helicopter speed, size, altitude, and capacity. Russia still has quantities of the record-setting "Hound" and ZPU-2 aircraft, and also has improved replacements. Soviet entries in recent Paris air shows leave little doubt as to the Russians' abilities in aircraft technology, or ambitions in the airmobility field.

We must counter employment of the helicopter, just as we counter any development giving substantial advantage in combat power or mobility.

Undoubtedly new specialized weapons will be produced. When, at what cost in personnel, training, logistic support, and in what quantities will we receive them? Possibly a faster method and more satisfactory answer would be the improved training and use of weapons already in the hands of troops.

Heat-seeking and noise-seeking missiles, radar fire direction, and large caliber weapons are relatively ineffective against low-flying helicopters, because of their proximity to ground sources of heat and noise, terrain interference to radar, and the extremely short engagement time. Furthermore,

the entire zone cannot be controlled, even with specialized weapons. Until the Chapparel/Vulcan Battalions [employing missiles and 20 mm machineguns] are deployed the U. S. division will not have organic air defense artillery capabilities.

Air defense emphasis has been placed on missiles, radar and early-warning systems to be employed primarily against high performance aircraft at medium and high altitudes. Some recent interest has developed in reissue to divisions of 40 mm and 50 caliber antiaircraft systems. Our loss of five high performance aircraft to machineguns over North Vietnam in March 1965 indicates that this is a feasible action, and demonstrates that machineguns can shoot down even supersonic aircraft having substantial stand-off ranges. Their coverage, however, will remain limited.

Antiaircraft fire, fighter aircraft, friendly and enemy artillery and mortar projectiles (especially proximity fused ones), combine with air traffic control requirements to make altitudes of more than a few hundred feet untenable for helicopters. For these reasons helicopter forces have developed and employ contour flight and nap-of-the-earth techniques.

The terms contour flight and nap-of-the-earth are used here as defined in Technical Memorandum 1-62, U. S. A. Human Engineering Laboratories, Aberdeen Proving Ground, Md.

"Nap-of-the-earth flight takes advantage of all natural terrain features, flying down gullies and river beds, around trees and hills, and reaching a designated point by any route which affords maximum cover."

"Contour flight is accomplished by flying as close to the ground as possible without altering course, rising only to clear trees, hills, or any objects along the way—literally flying the contour of the earth."

Of the two techniques, it becomes readily apparent that contour flight provides advantages in air navigation, a reduction of pilot fatigue, ability to detect, observe and identify enemy targets, and to accurately report their locations along the route of flight. Nap-of-the-earth flight provides maximum security and surprise. We can expect that at altitudes of less than 100 or 200 feet contour flight will be employed, except when forced to nap-of-the-earth techniques by passive defense requirements. A combination of the two will provide the optimum mix of mission accomplishment, security, and surprise.

In active air defense, ground units engage enemy targets as soon as they come within range and attempt to destroy them or to prevent them from accomplishing their mission. Units without air defense coverage employ active defense only when passive defense measures have failed or are clearly impractical. Passive defense takes maximum advantage of cover and concealment, dispersion, deception, warning systems, electronic security, and light discipline.

The primary disadvantage of passive defense, other than the fact that none of the enemy is destroyed, is that it is becoming inadequate, due to modern methods and systems of target acquisition using infrared detection, moving target radar, and advanced aerial photography. Concealment is largely ineffective, and no modern, mobile army can effectively function for long without radio communications and the resultant electromagnetic radiations. Passive air defense is suitable against enemy weapons systems which have not employed the more modern target acquisition means and when offensive capabilities are lacking.

In using low-level tactics to avoid sophisticated ground fire, helicopters come within range of individual fire. Weapons available within most units include one or more of the various 30 or 50 caliber machineguns, individual automatic and semi-automatic rifles, all adequate from the standpoint of range, accuracy, and power to combat helicopters. The only limiting factor is the inability of the marksman to deliver accurately aimed fire. Marksmanship ac-

The Russian MI-10 made an impressive appearance at a recent Paris Air Show

MAJ Kendall was assigned to the Dept of Fixed Wing Training, Ft Rucker, Ala., when he wrote this article.

Low level flight brings helicopters within range of individual fire

curacy can only be acquired by training and practice.

What training can we assume the Viet Cong have had, considering they have been engaged in combat with themselves, the French, or the United States since childhood? At least the hard core have had formal military training along the lines of a known distance and/or trainfire marksmanship program. We know, also, they are now frantically establishing moving-target training, using aircraft silhouettes and a system of ropes and pulleys to simulate aircraft in flight. Allied forces overrunning battalion sized VC training areas have discovered these targets on numerous occasions. Such training, under guerrilla warfare conditions, indicates that the Viet Cong place great importance on the need for moving-target training. However, the United States does not use moving-target training.

At Ap Bac, Vietnam, in 1963, we sustained great losses of helicopters and Vietnamese troops during an unsuccessful operation. A great amount of discussion centered around the reasons for this failure: (1) The timidity of the RVN troops in establishing the offense, or (2) Viet Cong troops were beginning to exploit the vulnerability of airmobile forces by improved accuracy of fire.

In July 1965, at Dong Xoai, Vietnam, the Vietnamese troops we landed experienced a high casualty rate, with the first battalion landed having more than 95 percent casualties. The possibility that the VC forces had recently engaged in moving target training is not remote, and could well have been the reason for the failure. In any event we cannot afford to ignore lessons so painfully learned, and we can reasonably assume that our enemies will profit from our experience in Vietnam.

U. S. Army basic marksmanship training is devoted to principles of mass firepower. The trainfire program is excellent in teaching the techniques of detecting and engaging targets, but it neglects known distance and moving-target marksmanship. Targets which are termed "moving" are actually disappearing or bobbing, so that emphasis is on stationary objects. Even this training is of insufficient duration, approximately 75 hours of total training. There is little real continuation of training for the vast majority of soldiers. One qualification period each year is required, but is not sufficient practice to maintain marksmanship ability.

Machinegun training for ground units is much like that for rifles. The moving target recommended for the 50 cal. mg (M-2) consists of a silhouette towed at 15 mph with little change in elevation. No moving target is recommended for the 7.62 mm M-60.

It is possible we are neglecting essential training in the hope that new and better, specialized, weapons will be produced. Excessive dependence on limited Air Defense artillery is unsafe, and another specialized weapon for the already overburdened soldier may not be the answer.

The American soldier is reasonably familiar with several types of individual weapons; he has the desire, intelligence and ability to become an excellent marksman. The only things lacking are training and practice. The cost of training, although substantial, is not great when compared to the cost of a missile or other specialized weapon.

Time available to aim and fire is a most important consideration in development of antiaircraft capability. From the following chart, reproduced from "The Employment of Helicopter and V/Stol Aircraft in Counterinsurgency" by Sikorsky Aircraft Division of United Aircraft Corporation, some idea can be obtained as to the time we can expect the target to be visible.

It can be seen that increased speed of detection and aim, and preparation of fields of fire will substantially increase helicopter vulnerability. The short exposure time severely limits use of crew-served weapons, but is within the reaction capability of well-trained riflemen.

The first major attempt to teach moving-target marksmanship was during World War II. Hundreds

of aircraft gunners and pilots were needed to shoot from aircraft. It was soon discovered there was little difference in shooting from a moving platform and in shooting at a moving target. Pilots and gunners were given the usual, known distance marksmanship course, and period of training with the 30 caliber machinegun. Tracer ammunition was used, both for indoctrination and to prove beyond doubt that hitting moving targets required an angle of lead in direct proportion to speed and range of the target, as well as its relative angle to the shooter. The natural, but incorrect, assumption of the trainee was that projectiles traveling at 3,000 feet per second made lead requirements negligible.

Another obstacle to overcome was the inherent and involuntary "visual pullback" which is associated with the marksman's desire to look at the target instead of in front, along the flight path at a mentally established aiming point in space, which the projectile and target will reach simultaneously. Visual pullback can be directly attributed to unfortunate but necessary requirements of both known distance and trainfire training methods.

After a few training periods, gunnery instructors began to notice a definite pattern—students who had moderate experience with shotguns were consistently far ahead of the rest in ability and retention. Students who had extensive training shooting skeet or other moving targets required only the most basic training with either rifle or machinegun.

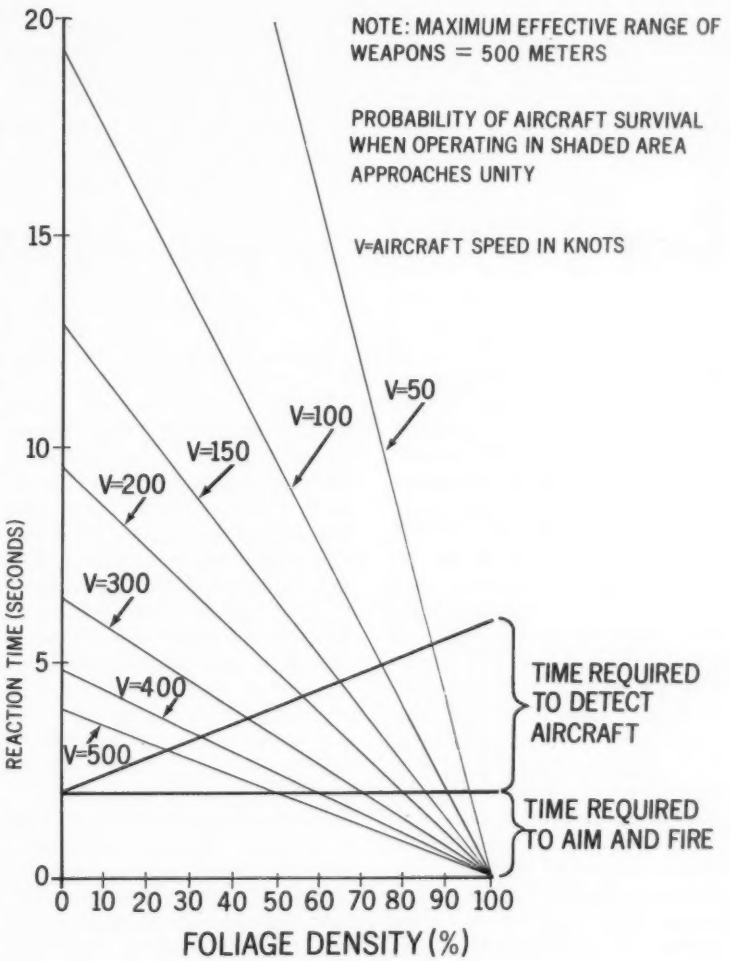
Tests were conducted to determine the value of skeet shooting as an aid to aerial gunnery training. Test results were remarkable: skeet shooting was helpful, not only in initial training, but in maintaining the ability of gunners awaiting assignment, and among operational aircrews. Both the Navy and Army Air Forces made maximum use of skeet in their respective training program. The Navy, in particular, required skeet shooting before machinegun training.

Eventually, developments in radar, increased aircraft speeds, and sophisticated weapon systems virtually eliminated the need for aerial gunners using visual sighting methods. Financial support of skeet ranges was discontinued, so that now the cost of shooting is prohibitive to the lower ranks.

With the helicopter we have returned to essentially the same era of antiaircraft and aerial fire which existed during World War II. Additional factors of maneuverability, lower altitude capability, and employment of airmobile tactics, make the helicopter an even more formidable threat than the aircraft of World War II.

Although skeet can be expected to contribute to ability and con-

TIME AVAILABLE TO GROUND TROOPS FOR AIMED ANTI-AIRCRAFT FIRE WITH VARIOUS FOLIAGE DENSITIES



Defense Against Airmobile Forces

fidence in engagement of aerial targets, it is not logically considered a complete training program. Firing at towed targets, use of blank ammunition, and light sources aimed at photoelectric sensors mounted on aircraft would also be valuable training means. A motion picture projected target similar to the joint Air Force/ Crossman Arms Company pistol marksmanship course might be modified and adopted.

One important factor to consider is that initial training is not sufficient, the ability must be maintained by constant practice. One or two familiarization or qualification courses a year is not enough practice for professional soldiers.

In this period of specialization, nuclear weapons, missiles, and mechanized foxhole diggers, we should remember that the logistical support on which we depend so heavily is most vulnerable to airmobile attack.

In our attempt to achieve advantages in firepower, we should remember the definition of firepower in FM 23-71, "firepower is bullets hitting people."

Bullets erratically spraying the area or sky will do little for our capabilities in airmobile defense against a trained and determined enemy.

Helicopters will employ low-level flight techniques away from heavily defended areas, and are vulnerable to accurately aimed small arms fire. U. S. Army rifle marksmanship is inadequate for defense against airmobile attack. Primary reasons for this deficiency are:

- Excessive dependence on specialized air defense weapons.
- Lack of moving-target training.
- Insufficient time is allocated to marksmanship training.
- Funds are not readily available to support informal, off-duty, marksmanship practice.

Recommendations proposed based on this study are:

- Incorporation of moving targets in basic, advanced and annual marksmanship training programs.
- Financial support to informal, off-duty, shooting sports for Army personnel.
- Command emphasis on marksmanship ability, accuracy, and maintenance of that skill, especially among combat support personnel.

Know your flight surgeon--he wants to know you

Major Joseph R. Cataldo

I ACCEPT THE sacred charge to assist in the healing of the mind as well as the body."

These words begin the Flight Surgeon's Oath. They constantly remind him of the need to evaluate the mind of an aviator as well as his physical condition. When there is inflammation of the eardrum, burning of the urine, pain in the chest, or other physical signs, it is relatively easy for the flight surgeon to say "No flying."

To forecast impending disease of the mind, even mild reactions to flying stress, is a challenge faced by all flight surgeons. In the aviation world the pilot is surrounded by unrealities, drama, and escapism; yet he is also aware of the danger on routine flights as well as combat missions. Each aviator knows there will be a certain number of accidents in a given period of time, and he knows many of these accidents will be attributed to human error. What is his reaction to this "flying stress"?

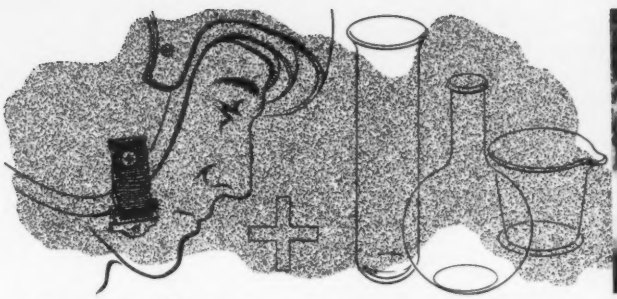
One mechanism is denial. A study done in WW II on Air Force pilots found that the pilots denied unpleasant realities; they had "an altered view of death." Not seeing the enemy himself, they were attacked by planes or flak. It was an impersonal thing. Even when evidence of death is presented to a pilot he often reacts with "It can't happen to me."

Some pilots, however, feel "It will happen to me; it's just a matter of time." When it doesn't happen, he begins to feel that each individual flight becomes his turn. He then becomes different. He loses his desire to fly, he begins to drink alcohol more, *he is unable to sleep well,* he becomes fatigued, and he jumps at the slightest noise. His irritability is really a sign posted on his shoulder which says "I'm tired and a little depressed."

This man is ready for an accident. He is conditioning himself for an accident. These signs are well known to the flight surgeon, and this is why he *must* observe the flying situation, fly often with his men, and get to share their problems.

Get to know your flight surgeon; he wants to know you. Flight surgeons are clinicians who treat, but they are also teachers. They want to keep you flying—safely.

MAJ Cataldo is Group Flight Surgeon, 17th Combat Aviation Group, APO San Francisco 96240.



☼ ☾ ♀ ♄ WEAPONS EXHAUST STUDY ♂ ♃ ☿ ♀ + ♃

ALTHOUGH SOLDIERS have been breathing exhaust fumes from weapons for years without apparent harm, medical personnel have been concerned that these gases may have an effect on aviators flying armed helicopters. This is especially true in the heavily armed helicopters equipped with rapid-fire weapons, and ventilation systems that permit fumes to accumulate in crew compartments. While the fumes are often quickly vented out, they may still create a hazard. Carbon monoxide is a principal component of the exhaust gases of weapons and it could affect the perception and judgment of the pilots in a short time without their being aware of it.

Personnel of the U. S. Army Aeromedical Research Unit at Fort Rucker, Ala., became interested in the problem after talking to crews evaluating new weapons systems. During the sustained rapid firing tests, which involve faster expenditure of ammunition than most combat situations, some of the gunners had complained about eye irritation, nausea, and difficulty in breathing, all thought to be due to the fumes.

To establish a proper approach to the problem, it is necessary to find out the exact composition of the gases and particles which come out of the weapons. A tri-service study called project WEST (*W*eapons *E*xhaust *ST*udy) was begun in mid-1966 to perform the required laboratory studies. To acquire this basic information the tests are being done with live ammunition fired from aircraft type machineguns (such as the M-2 and M-60). The 2.75" FFAR rockets are also statically fired.

The Air Force Rocket Propulsion Laboratory has provided a special test stand and will do many of the chemical analyses. The chemists will be very careful to analyze the gases as soon as possible, even within a few seconds in some cases, after firing because the exhaust gases may be very reactive chemically after leaving the weapons and storage before analysis would give incorrect information. Thus, present research is an effort to provide samples of the exhaust in the same composition and quality as it is at the time the aircrew breathes it.

Some of the instruments used in the study (such as the high resolution mass spectrometer and infrared spectrograph) are the same as those used in the design of rocket fuels. In the field, the gases have been trapped by a steel chamber around the weapons to give the scientific instruments a better concentrated gas sample to analyze.

After materials in the exhaust have been identified and their relative quantities have been measured, the amount of exhaust present in armed helicopters during combat operations will be measured by the Army Aeromedical Research Unit. The risk of injury or performance degradation in the aircrews can then be decided from available data on the toxicity of the various materials and the time-concentrations measured in the aircraft. Consultants from the Naval Aerospace Medical Institute (Pensacola, Fla.) and from an advisory committee of the National Academy of Science are helping the Army and Air Force scientists in planning the tests and evaluating the results.

Army Aeromedical Research Unit scientists report that measurements have already been done on a number of armed helicopters and have indicated that no hazard exists in the average combat situation. Also, new helicopter weapons systems such as the HueyCobra and Lockheed AAFSS have well sealed cockpits that limit the entry of the weapons exhaust.

Nevertheless, the Aeromedical Research Unit flight surgeons point out that despite these encouraging findings, very toxic materials including lead dust, cyanide, ammonia, nitrogen dioxide and of course carbon monoxide are being found in the exhaust of the weapons and the methods for ensuring adequate air purity in helicopter cockpits must be fully developed.

Aviation Testing at the Arctic Test Center

Major Nelson E. Luce

THE NATION not prepared to fight under extreme climatic conditions is inviting disaster. As a result of experience gained during World War II, which demonstrated that the United States Army was not prepared to fight under adverse conditions, the War Department organized a group of task forces to test U. S. Army equipment under arctic and subarctic conditions.

Task Force Frigid and Task Force Williwaw tested U. S. Army equipment during 1946 and 1947. Although these task forces gained a wealth of information, there were limitations and disadvantages that made this type of operation expensive and impractical. Time required to establish units on test sites, logistical support, acclimatization of personnel, and a lack of continuity after each exercise were major disadvantages in the use of task forces. Based on the result of Task Force Frigid, it was recommended that a permanent test organization be established, with test groups representing each of the permanent boards located in the Zone of the Interior.

In 1949, the Department of the Army ordered the organization of the Arctic Test Branch at Big Delta Air Force Base (now known as Fort Greely, Alaska). A cadre for the organization was activated at Fort Knox, Ky., in March of 1949 by the transfer of personnel from each of the Army Field Forces boards located in the Zone of the Interior. The organization moved to Big Delta Air Force Base in July 1949, and test operations were initiated. In 1957, the Arctic Test Branch was designated the U. S. Army Arctic Test Board with the mission of conducting arctic service tests of all Army field equipment.

In August 1962, as a result of reorganization of the Army, the Arctic Test Board was established as a class II activity and placed under the command of the U. S. Army Test and Evaluation Command. It was expanded to absorb the Research and Development Office, Alaska, and the Technical Services Test Activities, both stationed at Fort Wainwright in Fairbanks, Alaska, and the Chemical Corps Test Activity, Fort Greely. With this expansion came the additional mission of conducting engineering type tests to include integrated engineering service tests. This required an organizational realignment and a requirement for a greater instrumentation capability. On 1 March 1964, the U. S. Army Arctic Test Board was redesignated the U. S. Army Arctic Test Center.

The Army aviators assigned to the Aviation, Avionics, and Aerial Surveillance Test Division operated assigned aircraft from unprepared snow covered areas, frozen lakes, glaciers, and mountainous terrain in the extreme

MAJ Luce is Test Officer, Aviation, Avionics, and Aerial Surveillance Test Division, U. S. Army Arctic Test Center, Ft Greely, Alaska.

An Army CH-47 hovers over the Susitna Glacier at the 7,500-foot level of the Alaska Range during the 1967 Arctic Winter Test

cold of the arctic winter. From testing a ski kit from the L-19 (O-1) and a winterization kit for the H-13 (OH-13) to challenging the operational spectrum of the CH-47, arctic testing of aviation equipment has been a distinct contribution to the development of more reliable equipment for U. S. Army soldiers.

Operationally, the crews have supported the aerospace laboratory at the 14,500-foot level of Mount Wrangel, relocation of evacuees of the Alaska earthquake, and numerous search and rescue missions whose grateful survivors owe their lives to the positive attitudes of these dedicated aviators and their flying machines. Alaskan sportsmen for generations to come will enjoy the harvest of the half million rainbow trout and silver salmon fingerlings that annually are transplanted to the more accessible lakes along the Alaskan highway in a joint effort of the Army and the Alaska Fish and Wildlife Department.

Progress of this magnitude doesn't come without some sacrifice. In August 1964, LTC Robert Allen was killed while recovering the body of a fellow soldier from an Alaskan lake. The airfield at Fort Greely, Alaska, has been named Allen Army Airfield as a lasting tribute to the former aviation division chief.

Environmental testing is a relatively new concept, and the effects of severe cold on plastics, alloys, and lubricants are not always predictable. The United States Army Test and Evaluation Command places the responsibility of testing these items squarely on the shoulders of these aviators.

Exploiting the full capability of a machine under arctic winter conditions is exciting and can be hazardous, but the satisfaction of overcoming the obstacles and completing a mission of service is extremely rewarding.

"We took off from Allen Army Airfield at 0200 with the temperature at minus 56° Farenheit and ice fog creating a zero-zero visibility condition. The expectant mother and the nurse were bundled up in the back of the UH-1B helicopter. Everything went fine until we heard a loud bang and felt the temperature drop. The process of learning can be painful. The crewchief discovered that the window over the pilot's head had blown out. All the warm air was soon replaced with a cold arctic chill. Twenty minutes to the hospital pad. The patient in an evacuation bag was fine; the rest of the crew, chilly. Ice fog at the airfield at Fort Wainwright compounded the problem. Landing at the hospital was attempted and aborted because of low visibility. On the second try a GCA approach brought us in on centerline over the high intensity lights. We hovered through a white-out powder snow to the rotating beacon of a waiting ambulance. The patient was transferred to the hospital with minutes to spare. The flight crew patched the hole with a blanket and returned to Fort Greely to a cup of hot coffee. We

WINDCHILL CHART											
	LOCAL TEMPERATURE (°F)										
WIND SPEED (MPH)	32	23	14	5	-4	-13	-22	-31	-40	-49	-58
	EQUIVALENT TEMPERATURE (°F)										
CALM	32	23	14	5	-4	-13	-22	-31	-40	-49	-58
5	29	20	10	1	-9	-18	-28	-37	-47	-56	-65
10	18	7	-4	-15	-26	-37	-48	-59	-70	-81	-92
15	13	-1	-13	-25	-37	-49	-61	-73	-85	-97	-109
20	7	-6	-19	-32	-44	-57	-70	-83	-96	-109	-121
25	3	-10	-24	-37	-50	-64	-77	-90	-104	-117	-130
30	1	-13	-27	-41	-54	-68	-82	-97	-109	-123	-137
35	-1	-15	-29	-43	-57	-71	-85	-99	-113	-127	-142
40	-3	-17	-31	-45	-59	-74	-87	-102	-116	-131	-145
45	-3	-18	-32	-46	-61	-75	-89	-104	-118	-132	-147
50	-4	-18	-33	-47	-62	-76	-91	-105	-120	-134	-148
LITTLE DANGER FOR PROPERLY CLOTHED PERSONS			CONSIDERABLE DANGER			VERY GREAT DANGER					
DANGER FROM FREEZING OF EXPOSED FLESH											

learned something about temperature differential on plastic windows."

The easy going description of a routine medical evacuation reflects the confidence that there really was no other way. Somehow, when it is —56° F, automobiles balk and anywhere is too far to walk. There is a magical sound in the turbine of the modern helicopter that exudes confidence.

The windchill chart on this page indicates what is expected of an arctic crewchief. He still stands fire guard in the rotor wash of a starting helicopter. His issue of clothing includes a parka, vapor barrier boots, and heavy arctic mittens. On all flights he carries an individual survival bag with a double sleeping bag, air mattress, rations, signal flares, weapon and ammunition.

We speak from personal experience when we say that you can be comfortable in an aircraft parked in a snowbank with the outside air temperature at —45° F and the wind in excess of 60 mph. Our crewchief put all the seats outside and stacked the unnecessary cargo beneath the tail boom of the UH-1B. We inflated our air mattresses and crawled into our double arctic sleeping bags and watched the frost grow on the inside of the copter. Every hour we would turn the heater on for five minutes. When the high altitude search party flew across the pass we ignited the flares and 12 hours later a convoy of tracked vehicles and snowplows rolled alongside for the rescue operation. We really hated to part with our snug little nest.

We publish regulations and we talk up survival preparations every opportunity we have, yet we continue to pick up stranded hunters or stalled motorists who face the possibility of walking through the arctic with hopelessly inadequate equipment. Low-quarter shoes and cowboy boots are comfortable when the car runs, but a 9-mile walk in low-quarter shoes at —35° F cost a man both feet this winter. In our business of arctic testing, we evaluate problems in our equipment but we rely on the individual to take care of himself. Occasionally, we hear a mumble from a new arrival as he carries his bag out to the flight line. We don't say much but we make it a point to come to a hover over a glacier or set down on a ridge line at 9,000 feet. The view is impressive and the thought of walking out is casually dispelled. It is amazing how much gets packed in the bag for the next trip out.

The criteria against which test aircraft are measured is established by Combat Developments Command for each product in the form of military characteristics, qualitative materiel requirements or small development requirements. In these documents an aircraft is required to start and operate independently from auxiliary preheating down to —25° F. With less than one hour preheat, and using an auxiliary power unit, the aircraft must start and operate down to —65° F. Additionally the aircraft heater requirements are spelled out. With ambient temperatures down to —25° F and normal heating system must operate and provide a cabin temperature of +40° F within 10 minutes after operation begins. With a winterization kit, the heating system must provide a cabin temperature of +40° F within 10 minutes after operations begins at —65° F. Defrosting and deicing capability are evaluated. There aren't a large number of items, air or otherwise, that pass these standards with flying colors.

Mobility in the arctic regions of the world is, perhaps, a greater problem in the summer than in the winter. There are few roads and what passes for an acceptable trail in the frozen ground of the winter months becomes a quagmire of unpredictable depths during the months of the midnight sun. Muskeg remains an obstacle to vehicles of all types. Muskeg can trap the unsuspecting helicopter pilot who shuts down and walks away to look back at his settling helicopter that is resting up to its belly with a tail rotor nestling in the grass. High flota-

tion landing gears not only serve as skis in the winter but must support the weight of the machine on the muskeg in the summer.

Summer produces another problem unique in the arctic. The movement of so many huge glaciers produces a glacial silt that is carried along every major river in Alaska. This talc-textured granite is blown by the winds to settle everywhere. Stirred up by natural winds and aggravated by the mechanical rotor wash of the helicopter, "loess," as the geologist calls it, has a tremendously abrasive effect on the leading edges of rotor systems. Because it is so fine and penetrates the best of seals it is highly abrasive to internal bearings and is the probable cause of many premature failures.

Alaska is the land of extremes. The majestic height of Mt. McKinley is the highest point in North America. On the 21st of June, and for several days before and after, the sun remains visible 24 hours a day. This produces psychological extremes as well. After a day's work, there is the rewarding job as an umpire for the little league. The weather is fine and after the last hot dog and the score is 12 to 1 in favor of the Braves, some kid wants to go fishing. Knowing that you can match up a 6 year old boy and a 6 pound trout, it is hard to avoid the three mile hike. It is also three miles back and by the time you tuck the sleepy kid in bed and put the trout in the freezer, it is time to go to work. Remembering the darkness and the deep cold of the winter, sleep seems like a complete waste of time.

The horizons are unlimited. These arctic aviators are planning ahead for five years. They speak in a language of their own of developing image intensifiers for night operations, automatic guidance systems, and giant cranes that can lift 40,000 lbs.

The aviators enjoy their work. They share the love of flying as a common bond. Respectfully exploring every valley and crevasse they quickly become experts in local topography. A current survey of the magnificent migratory herds of wild animals is a dividend of the added dimension of mobility. Among pilots there are romanticists and there are realists, and at the Arctic Test Center there are both. The imagination, courage, and dedication of these aviators will produce the best possible equipment for going anywhere, anytime.

Muscle Where It's Needed

A U. S. Army CH-54A Flying Crane helicopter lifts a 59-foot, 15,000-pound steel section into place over the Ngan Son Bridge in South Vietnam. The bridge, part of the route 1 supply line destroyed by the Viet Cong, was rebuilt and reopened to truck convoys within five weeks. Without the use of the CH-54A, Army engineers estimated the reconstruction would have taken up to six months.

The Sikorsky-built Flying Crane, with a maximum payload of 10 tons, lifted 10 steel spans into place. Each of the heavy-lift operations took less than 30 minutes. The CH-54A, operated by the 478th Aviation Co., in support of the 1st Cavalry Division based at An Khe, about 35 miles northeast of Qui Nhon, has a maximum payload of up to 10 tons.

Aviation medicine extends from the laboratories to battlefields such as the one above in Binh Dung Province, RVN

Aviation Medicine

where did it come from—what does it do?

Captain Thomas J. Bourgeois

AW, C'MON DOC, DO I need that shot now? I have a golf date at 2 o'clock!"

"Sorry, Mac, you're 20 pounds overweight and until you're down again, I'll have to ground you."

"No sir. No physical, no flying!"

How often have you heard these phrases? If you've been in the flying program very long, it is a safe bet that you've heard similar statements made by the flight surgeon. Although Army aviators have long since stopped viewing the flight surgeon as an ogre out to ground them, not many actually know him. Most of us simply take him for granted — since he has always seemed to be there.

Aviation medicine got its start in the early balloon flights late in the 18th Century. In France on September 18, 1783 the first flight was made in which animals were sent aloft. About a year later an American physician, Dr. John Jeffries, made the first of several balloon flights with the French balloonist Francois Blanchard. They made a number of scientific observations of medical interest on the temperatures aloft, changes in barometric pressure, and composition of air.

Thus, the beginning of aviation medicine. How does this affect us? Every day that we leave Mother Earth, the findings of aviation medical personnel and their developments for safer flight, both of man and machine, have a bearing on Army aviators.

Going back to April 15, 1875 we find that Joseph Eustache Croce-Spinelli, Henri Theodore Sivel, and Gaston Tissandier of France made a high altitude balloon ascent that left a graphic record of disaster. Their balloon ascended to 28,820 feet and de-

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scended without guidance or manipulation due to the unconscious state of the three occupants. Only Tissandier survived the flight, but he was able to detect the want of oxygen, loss of consciousness, and his own recovery as the balloon descended into denser atmosphere. To these balloonists we must attribute our first knowledge of the effects of a lowered barometric pressure as it occurs in ascent in flight. Therefore, the need for an oxygen supply for higher altitudes was recognized.

Very little progress was made in aviation medicine after that time until World War I, when studies of medical problems associated with flying were greatly accelerated. By this time the heavier-than-air machine was under active development and an Air Service had been established under the Army Signal Corps.

The appalling death rate due to accidents and the quest for higher flight altitudes stimulated the formation of physiological and psychological laboratories and schools to train flight surgeons. Some of the finest professional talent in Europe and America was assembled and aviation medicine emerged as an organized medical specialty field. These doctors are credited with reducing the fatalities due to flying accidents by more than 50 percent.

In Great Britain, in the first year of World War I it was determined that of every 100 aviators killed, 2 met death at the hand of Germans, 8 died because of defective aircraft, and 90 because of their own deficiencies. Of the latter, 60 deaths were found to be due directly to physical defects.

Army aviation has benefited greatly from continuous medical research

Here the need for flight surgeons became evident, and their name as we know it today came into being. As you can realize, the physical requirements for aviator personnel started to form, and greater restrictions were placed on these individuals. The need for a pilot with "an alert mind in a healthy body" was amply demonstrated in that first World War, and this has been the basic tenet ever since.

The slow growth of aviation and aviation medicine was evident from the end of World War I in 1918 to about 1938. Then the threat of World War II gave great impetus to both aviation and aviation medicine. In the latter part of this period the great network of world airlines began to form. Thus many giant steps were taken in both military and civilian aviation in the late '30s and early '40s.

With the conclusion of the war, the jet age was ushered in, and many new problems arose in aviation and aviation medicine. Medical men, together with an array of talent in the allied sciences, devoted their professional careers to solving these problems. Today we have thousands of scientific personnel and research organizations pooling efforts to prepare man for flight in outer space. Medicine is a corelative part of every advancement.

Just what is involved in the practice of aviation medicine from the pilot's view? A few of the many jobs and responsibilities of those in aviation medicine include the medical aspects of selection and classification of pilots and aircrew personnel; the maintenance of health, efficiency, and safety of aircrews; the prolongation of flying careers; the prevention of disease and injury peculiar to aviation; prevention of dissemination by aircraft of disease and harmful insects; the air transport of the sick and injured; rescue and survival; the aeromedical aspects of aircraft design; and the development of personal equipment that is required for the welfare and safety of aircrew personnel.

The Army aviator first encoun-

Medicine always has been present on the battlefield in the form of field hospitals such as the Army's 93d Evacuation Hospital (above) located about 20 miles from Saigon. During the Korean War in the early 1950s the effectiveness of field hospitals was greatly increased by Army medical evacuation aircraft. Below, an H-13 (OH-13) arrives at a field hospital with a soldier moments after he was wounded during a Korean war battle in 1952. In addition to getting the wounded to medical aid faster, Army aircraft eliminate many bumpy, dusty rides from the front line unimproved roads that many wounded could not survive.

ters the flight surgeon when he is given a flight physical before entering pilot training. He is examined to ensure that he is physically and mentally capable to endure the special demands and needs of flying an aircraft. Because of these demands, standards for selection of pilots are normally prescribed by a government agency (Federal Aviation Agency).

From that first encounter the aviator will continue to see much of the flight surgeon, who will take part in the aviator's flight activities, and even engage in hangar talk with him. Indeed, it is through a working association away from the formality of the office that many flight surgeons feel they are best able to contribute to the personal practice of aviation medicine. That way they are able to know their patients and can recognize intangible but incipient psychological pressures which might endanger the life of the aviator and his passengers.

In addition to this type of relationship, the aviator must see his flight surgeon for an annual physical examination. Both civil and government agencies usually require that an aviator undergo a comprehensive annual physical examination. This detects any troubles while they are still small and correctable and ensures the safety of an aviator from the medical standpoint. Besides the annual physical, the flight surgeon is the aviator's personal physician all during the year — when colds slow him down, minor cuts and bruises appear, or there's a major illness.

It is on the personal physician-patient relationship that the flight surgeon is best known to the average Army aviator. But the aviation medical specialists serve in many other capacities to ensure the well-being of the pilot and the safe operation of his aircraft. He is engaged in research to find

out the effects of various elements on the aviator in flight, those of both natural and mechanical environments. He teaches other medical service personnel and educates the aviator and his family on the medical aspects of his job. He helps design and develop special equipment needed in the sometimes hostile environment encountered in flight. He is concerned with the whole man in his relationship to flight — and with this concern comes safety of flight.

This one factor, safety, has probably had more influence on the design and operation of aircraft than any other one criteria. It is so important in today's aviation world that not only the flight surgeon but also numerous civilian and military organizations are concerned with its various aspects.

While some solutions have been advanced to aviation medical safety problems, many still concern us today. Aircraft must be designed to overcome hazards such as stability and positive control, structural integrity, reliability, performance, independence of visual reference to earth, airmanship and training, reliable ground navaids, and organization. To all of these add a most important one — the frailties of man.

Until World War II research was confined mainly to material developments, such as high strength alloys, corrosion resistance, performance, fuels, and communications. But more complex aircraft flying higher and faster have spurred research and moved it more into the area of human factors.

With this in mind, the design of aircraft and cockpits to fit man's physiological and psychological limitations was introduced. Man's ability to withstand extremes of temperature, vibrations, accelerations; his ability to coordinate as part of a team; to see, feel, hear, reach, and react — all became factors and fundamentals to safety in the new realm of flight.

Another important factor enters into the wide field of aviation medicine — man is placed in a situation of stress. Stresses, biophysical and psychological, disturb the fundamental equilibrium that the body strives to maintain. The inherent tendency toward stability in a normal body requires constant adaptation to changes in relation to gravity. Many adjustments have to be made rapidly for noise and vibration.

Pressurized compartments and cockpits help relieve these biophysical and psychological stresses. Aviation medicine has also come to our rescue again in relation to the mechanical characteristics which exert stress and strain. An example is the development in control relations of a modern booster system which relieves individuals of the need to exert strong control forces. Of course, this also removes that one sense of control — feel. So, an artificial "feel" has been built into each system.

Not only has aviation medicine had a part in redesigning cockpit and aircraft for the aviator's comfort, efficiency, and safety, but it has also helped develop auxiliary safety equipment. Today there are fire retardant flying suits and jackets, gloves long enough to cover the lower arm, helmets to protect the head, earphones to help direct and confine the sound to the place where it is needed, special survival equipment, and many other items for a more comfortable and safe environment. And many other items under development.

Have you ever stopped to think of the many contributions that aviation medicine has made to your well being and your career? Don't sell your flight surgeon short because he might interfere with a golf date or some other plan occasionally. He has good scientific reasons behind his decision — and it is for your well being. Without the man with the little black bag and stethoscope — and his colleagues in laboratories and at design boards — aviation could not have progressed to the threshold of space and beyond. He has stood at the aviator's side from the very first intrepid balloon and airplane flights. He stands with you now and will be there in the future.

Perhaps this comment by MG Otis O. Benson, Jr., USAF, commandant of the School of Aviation Medicine, sums up this cooperative effort: "Perhaps the greatest significance of aviation medicine lies in the fact that a group of professionally and scientifically trained men devote their attention, energies, skills, and knowledge to the human problems of flight. There is, thus, constituted an articulate group interested in the human element — the people who fly and all those affected by aeronautical activities. Also, there is available to aircraft designers, manufacturers, and operators a source of professional advice of which the basic concern is the welfare of man in aeronautics."

PROGRESS?

YES, JIM, 85 maintenance hours per flight hour is a bit high! But that is the figure quoted in the last paragraph of "The OH-6A Is Here" in the July AVIATION DIGEST. Really, though, our ratio is better than that. The correct figure should have been .85 estimated maintenance hour per hour of flight on the Cayuse.

Shades of 1940 — it seems the gremlins are loose again!

Hearing Loss

Captain Terry L. Schuetz

OF THE FIVE senses a human possesses, hearing is often considered the most remarkable, intricate, and delicate mechanism of them all. Even today, with all the advances in medical knowledge, much is yet to be learned about the ear and how it functions. We do know that the ear is subject to degeneration from age, exposure to sound pressure levels, and many other factors.

The aviator is concerned with sound pressure levels from the spectrum of sound of his environment. An important portion of that environment is the flying machine. Before we discuss the problems an aviator faces with this spectrum of sound and hearing loss, a brief, general knowledge of sound and how the ear functions is important.

Sound is caused by an object vibrating in air or other matter. The pitch of the sound is determined by the number of times the object vibrates per second (cycles per second, cps). The more rapid the vibration the higher the pitch; the less rapid the vibration the lower the pitch. Human speech ranges from 250-4,000 cycles per second. A normal human ear can detect a frequency range from 20-20,000 cycles per second.

Sound is also measured in degrees of loudness. The unit of measure is called the decibel (db). A doubling of sound energy will increase the sound pressure level 6 decibels. A power lawnmower has a sound pressure level of approximately 90 decibels at full throttle. Music at a comfortable listening level is approximately 80 decibels.

The ear mechanism is divided into three general parts. The external ear, the middle ear, and the inner ear (see diagram A). The external ear consists of the outer part, or the auricle, and the ear canal, part A. The middle ear contains three small bones called the hammer, the anvil, and the stirrup, parts D, E, F. The inner ear contains the cochlea, part I, which is divided by the basilar membrane along its length, and a great number of lymph-filled canals. In the cochlea are located nerves which give us the sense of hearing. It must be remembered that the ear is much more complex than what is stated here. We are discussing only those portions of the ear that deal with the sense of hearing.

When sound waves are caught by the auricle and reflected into the ear canal, they strike the eardrum, part B, and cause it to vibrate. The vibrating eardrum causes the three small bones of the middle ear, the hammer, anvil, and the stirrup, to vibrate and carry the impulses across the middle ear to the oval window,

CPT Schuetz was assigned to the Dept of Rotary Wing Training, Ft Rucker, Ala., when he wrote this article. He is now serving in Vietnam.

part G, which connects to the inner ear. As the oval window vibrates, there must be a way for the lymph fluid in the inner ear to move, and this is provided by a small round window covered with a delicate membrane, part J. As the membrane goes in and out, lymph waves are set up. These waves move tiny nerve endings in the cochlea, producing nervous stimuli which are carried through a branch of the auditory nerve, part K, to the brain where the mind transforms them into hearing.

How does all the above concern us as aviators? The answer to this question is simple. Many aviators today have a loss of hearing sensitivity at certain ranges of the sound spectrum due to constant exposure to high sound pressure levels from the aircraft.

To begin with, there are two types of deafness associated with sound in our case. First is a temporary deafness or fatigue which lasts only a few days. We experience this type of deafness after firing all day on the rifle range. The second type of deafness can be a permanent deafness which is caused by constant exposure to a high sound pressure level such as aircraft noise. To some individuals, this high sound pressure level induced deafness is temporary; however, to most it becomes permanent over a period of time. This does not imply that one becomes totally deaf. It just takes more volume or decibels to hear that particular frequency than it did before you started flying.

When the cochlea is continuously subjected to a certain frequency or noise of a high pressure level, the basilar membrane (see diagram B), a portion of the cochlea degenerates at a region associated with that frequency. It has been found that high frequency tones cause a degeneration of the basilar membrane near the oval window, part G, whereas the lower frequency tones cause a degeneration at the opposite end of the basilar membrane. Tones of the middle frequencies cause a degeneration in the midportion.

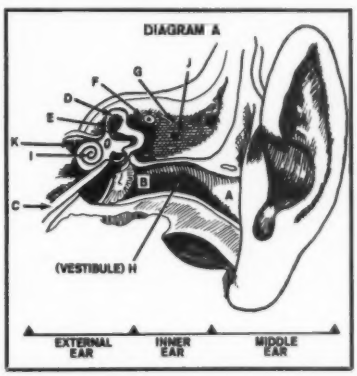
A 435 hp aircraft engine running at 3200 rpm generates approximately 120 decibels. The higher the horsepower the greater the decibel level. This 120 decibel level is about 1,000,000 times greater a force than the average ear is capable of detecting. This is analogous to weighing a 15 ton package on a postage scale. Constant overstimulation of the ear, that we experience when we fly, is a casual factor in loss of hearing.

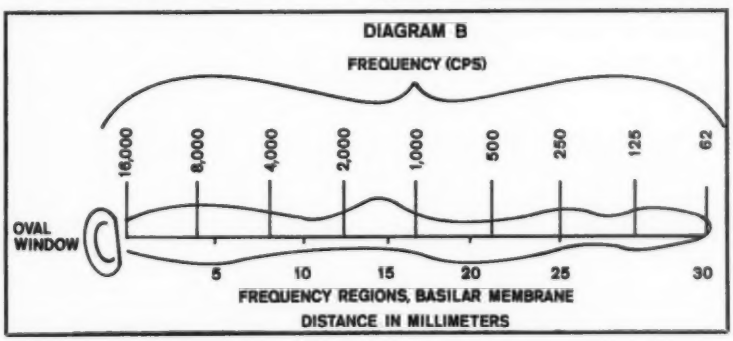
Since WW II, extensive studies have been made to design various devices to attenuate the sound level. To this date, the problem is not completely solved. Engineers tried to attack the source of the sound but found this route costly, and it imposed some engineering problems with the aircraft. Researchers and manufacturers have developed earmuffs with good sound attenuation characteristics. They are worn by Air Force and Navy line personnel for protection of their ears from jet engine noise.

Another effective ear protective device is the V51R earplug which is available to the Army aviator. However, many aviators fail to wear the earplugs because of discomfort. Since the standard APH-5 offers very little sound attenuation, it is advisable that earplugs be worn with the flight helmet.

Research is still continuing and efforts are being made to develop a helmet that will offer greater sound attenuation. Until such time as this is accomplished, we will have to depend on the earplug for ear protection.

No statistics are available as to the number of aviators grounded each year because of a hearing loss. But remember, a hearing loss caused by a high sound pressure level coming from aircraft noise can be a permanent loss of a portion of your audible hearing range. Only you — the Army aviator — can prevent this damage from happening or continuing. Wear your earplugs, regardless of the discomfort. A little discomfort is only a slight price to pay for retaining your hearing.





The man at the right and his colleagues are long overdue for

OVERDUE CREDIT

Major Eugene A. Beyer

I have often wondered how a crewchief felt when his pilot received an award and he a verbal "Well Done"

SINCE OUR buildup started in the aviation field for the South Vietnam conflict, immeasurable attention has been directed toward the helicopter pilot training program. This does not mean that the other requirements which go hand in hand with pilot training have been slighted, but let us say they have not been given the coverage. Let us pause now and consider just one of the parallel requirements of pilot training: the mechanic or crewchief. Even though the amount of money spent on training this individual does not approach that being spent on the pilot, let us give credit where credit is due.

The 67N20 course (Single Rotor Turbine Helicopter Maintenance Course) is a five week course with a very comprehensive curriculum. During this program, the crewchief candidates are presented classes in powerplants, air frame maintenance, fuel and engine lubricating systems, flight controls and hydraulic controls. If this is not enough to absorb, try a follow-up on tail boom and tail rotor, pylon system, electrical and utility systems, weight and balance, loads and inspections.

During this time, the prospective mechanic is given practical exercises where he actually rigs a tail rotor, or whatever the class may be on, for that particular day's instruction. Keeping in mind the five week course, his learning is also taxed with five days of tactics where he gets his gunnery training. To be a well-rounded crewchief these days a man must be able to keep his bird flying and his ordnance firing. This not only includes the weapons mounted on an armed helicopter but also his basic weapon, which in most cases is the M-60 machinegun.

With the family of aircraft the Army possesses at present, one can readily see the need for many types of mechanics, but like pilot training the emphasis is on helicopters. With the addition of the OH-6 into the family and the future additions of the Cobra and the AAFSS (advanced aerial fire support system), a varied and interesting field is open to helicopter mechanics.

Maintenance students, much like aviators, really begin to learn once they depart the Aviation School and put their talents to use. After they are assigned an aircraft, a sense of pride begins to build within the individual. He does the best he can and in most instances, he finds himself in a combat situation which stimulates the learning process. He enjoys, more than he will admit, keeping his aircraft flying. He works long, hard hours and I am sure he feels the weight of the world resting on his shoulders. Each day his bird flies, lives are placed in his hands. He knows just one little mistake can take the lives of his passengers as well as his own. There is mutual trust

MAJ Beyer was with the Dept of Rotary Wing Training, Ft Rucker, Ala., when he wrote this article. He is now serving in Vietnam.

between the pilot and crewchief. A helping hand is available to the mechanic in the forms of TMs and experienced personnel. An assist is given by the pilot in his preflight also.

Keeping in mind the fact that not all mechanics are assigned to South Vietnam, the emphasis in their training is directed toward that atmosphere of flying and working conditions. The bulk of Army aviation is now found in South Vietnam, so the majority of attention will be given to those individuals.

I am sure every pilot in Army aviation has had some personal experience with a crewchief or mechanic. All my relations have been cordial and every encounter with a crewchief seemed to point to the fact that the instruction given at the United States Army Aviation School is the highest caliber. Reports from South Vietnam have been very favorable, with comments of better quality and distribution.

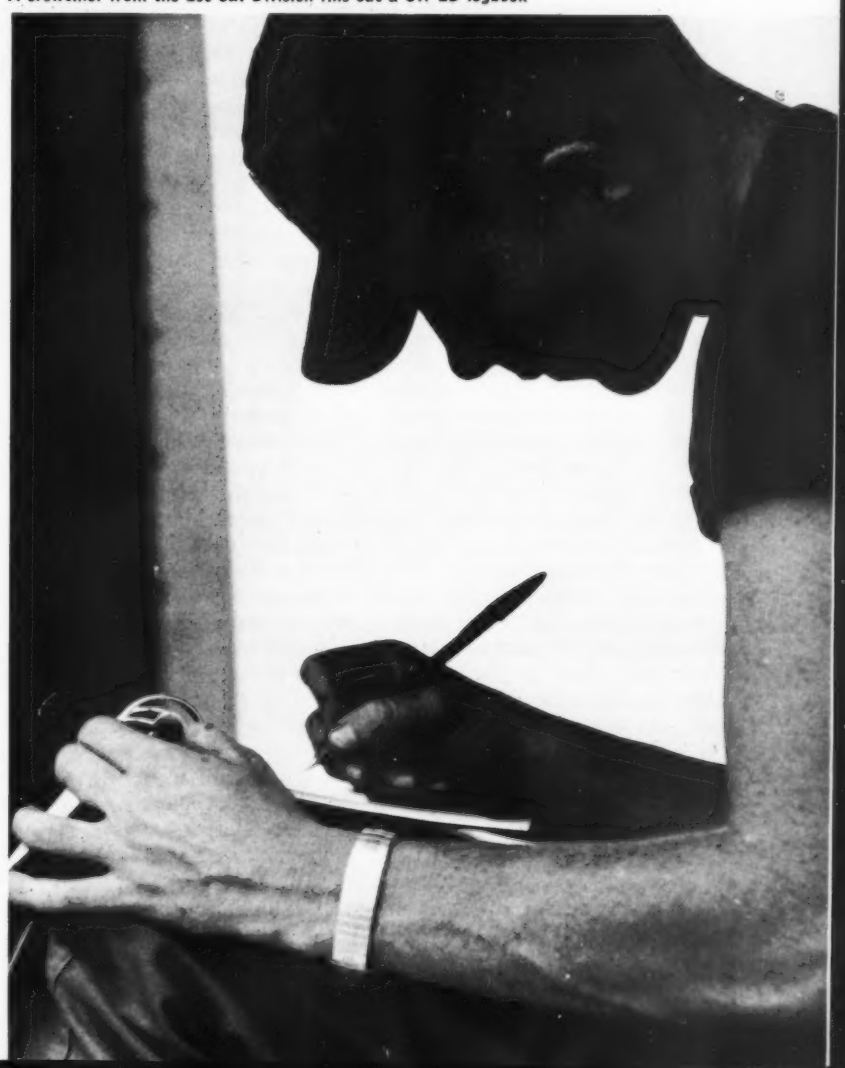
If one had access to records of crewchiefs' actions in emergency conditions in South Vietnam covering every situation and environment, a very interesting book could be written on their bravery and disregard for personal safety. A survey of Army aviators would surely be filled with stories of incidents in isolated outposts or water-filled rice paddies looking over a crewchief's shoulder apprehensively asking, "Can you fix it?"

The flight pay received by the crewchief is only a token of payment for the duties performed. Before any mission is flown, he is with his aircraft long before takeoff time to ensure that everything is in a state of readiness and safety. At the end of the flight and after the pilots have departed for debriefings, you will find the crewchief going over his aircraft once again.

With the coming of turbine powered helicopters, the ratio of maintenance manhours versus flight hours went down considerably, but the added responsibility of weapons and the combat environment lightened the load very little on the crewchief.

I have often wondered just how a crewchief felt when he learned that a pilot received a Distinguished Flying Cross or some other award for an act of heroism performed in South Vietnam and the only reward he received was a verbal "Well Done"? One might ask, Why a decoration when he is only doing what is expected of him and that it is an occupational hazard? The American soldier, especially the crewchief, works harder and gets less recognition for his efforts than any other citizen I can think of. The majority of crewchiefs return from South Vietnam with an Air Medal, Occupation Medal, and possibly a Commendation Medal or Good Conduct Medal. Less visible is the year's maintenance experience and the maturity most young crewchiefs achieve. A world of credit is due this breed of soldier —and it is overdue.

A crewchief from the 1st Cav Division fills out a UH-1D logbook



SLEEP

Lieutenant Colonel Charles R. Ogle

With all of our personal knowledge and with all of our scientific information available, nobody seems to know exactly how or why we go to sleep

DID YOU EVER wonder why we go to sleep? And after we've gone, why we stay asleep as long as we do? Or why a good night's sleep refreshes and restores us, while a loss of sleep makes us tired, irritable, and less efficient?

These are questions that everyone feels qualified to discuss because everyone has personal experience with the subject. Then what's to be gained by discussing a subject with which we are all so familiar?

Increased knowledge—the type of knowledge that could save your life, or perhaps the life of someone for whom you are responsible. How? The number of accidents that have been caused because of a lack of sleep, or the number of incorrect or poor decisions made by men whose efficiency was lowered because of a lack of sleep, would fill the pages of many books. And the average man does not give enough thought and consideration to the importance of this commonplace subject.

A great deal of scientific effort has been expended on the study of sleep. The data, studies, and books on the subject would fill a respectable library. But with all our personal knowledge and with all this scientific information available, nobody seems to know exactly how or why we go to sleep.

This is an interesting fact when we consider that the average man spends about one-third of his time sleeping. Some of us get more, some of us get less, but the average man will get about 8 hours of sleep during the normal 24-hour period. The exact amount varies with the need of the individual, the time, the place, the activity and the environment.

One of the first things that we observe in an examination of man's sleep habits is that his sleep is "monophasic" in nature. That is, he performs his sleep in one continuous period.

Man's period of sleep is usually taken at night. Whether this night sleep is the natural thing for man or whether it is just a habit, timed and formed by the social order, is an interesting question. Our society is certainly geared to a daylight operation.

Our sleep wakefulness cycle is geared to the 24-hour period corresponding to the natural one established by the earth's rotation. There is no substantial proof that the period of our sleep corresponds to the period of night by virtue of some law of nature. The sleep habits of men in an environment without a normal day-night phasing still retain the same sleep to wakefulness ratio.

There is evidence to indicate that in the sleep habits of the very young, a pattern develops that shows a distinct accommodation to the environment.

Scientists have determined that man is not just asleep or awake but that there are many stages of sleep that range from drowsiness to deep sleep. As an individual advances from one of these stages to the next he becomes more relaxed and less aware of his surroundings. As he moves toward the deeper states, his heartbeat, blood pressure, and respiration all tend to slow down.

In the first or drowsy state a person is easily awakened, and if

questioned may insist that he wasn't asleep at all. He can usually be awakened by a light or a sound. As a man drifts into the deeper stages of sleep it becomes increasingly more difficult to arouse him. He doesn't react as quickly to internal or external stimuli.

It would simplify our understanding if man began his night's sleep at the state of lightest sleep and then moved through the various stages to that of the deepest, there to remain until awakened. However, when the average man reaches the deepest sleep, he reverses the direction and passes back toward the lighter stages. The amount of time spent by an individual as he passes from one stage to the next, then from deepest back to light sleep varies with the individual. The full cycle usually requires 90-120 minutes.

Probably of greatest concern to us is what happens to a man when he is deprived of sleep or has his sleep pattern altered. A lot of information is available on this aspect of sleep because one of the most widely used techniques of studying man's need for sleep has been to observe him when it has been deprived him.

The effects of acute sleep loss in man will vary with the individual, the environment, the amount of deprivation, and the effect being measured.

Dr. Nathanial Kleitman, one of the world's leading authorities on sleep, states that no impairment of efficiency is obvious for a sleep loss of 24 hours. Beyond this period the effects vary with individuals, but common to all is a general loss of efficiency, physical discomfort, inability to concentrate, loss of attentiveness, and an overwhelming desire to sleep. Chronic sleep loss and the ability of man is best summed up by Kleitman: "The results of sleep deprivation experiments do not furnish information on the absolute wakefulness capacity of man because, as pointed out, after 48-60 hours of wakefulness, the

When he wrote this article COL Ogle was Chief, Literature Division, Dept of P&NRI, Ft Rucker, Ala. He is now serving in Vietnam.

Think before roughly shaking a mechanic or crewchief out of the sack

subject's condition and performance are so far below the usual wakefulness level that the term 'wakefulness' loses it acceptable meaning."

We can conclude that man must have a certain amount of sleep if he is to remain efficient. We see that beyond 24 hours of wakefulness, he becomes inefficient. We also noted earlier that man gets about 8 hours of sleep during each 24-hour period and this is usually done in one "sitting."

This natural schedule will not be acceptable in many cases. Suppose, for example, that a crew of three men are on a flight to the moon. One man must be on duty at all times. The crew duties are such that the maximum time that they can continuously perform these duties is 4 hours. The scheduling problem is obvious.

Alteration of the normal sleep-wakefulness cycle of 8 hours sleep followed by 16 hours of wakefulness has been tried experimentally to determine the most efficient ratio of work to rest periods.

The "watch system" of the Navy and Merchant Marine providing for 4 hours on duty and 8 hours off duty has been used successfully for years. This alters a man's ability to get 8 hours sleep in one period, but otherwise in no way decreases his efficiency.

O. S. Adams and W. D. Chiles conducted some of the earliest experimental studies on the performance of individuals under varying duty-rest period schedules. The experiments were conducted over 96-hour periods and the schedules included:

Hours at Duty	Hours at Rest
2	2
4	4
6	6
8	8

The results of these tests suggested "that for both active tasks (mental arithmetic and pattern perception) and the passive tasks (monitoring and vigilance) the 2 and 4 hour shifts were preferable."

A second group of experiments that followed the schedule listed below, also for a period of 96 hours, was conducted later:

Hours of Duty	Hours of Rest
4	2
6	2

Neither was found to be better. However, the individuals following the 4 hours of duty and the 2 hours of rest schedule averaged 5.5 hours sleep during each 24-hour period, whereas the 6 and 2 got less than 4 hours of sleep. This minimum amount of sleep may not be adequate over long periods, depending upon the individual and his duties.

Additional studies were subsequently made that followed 4 hours duty and 2 rest, and 4 duty and 4 rest schedules for periods of two weeks. Conclusions confirmed the 4 hours duty and 2 hours rest schedule provides for acceptable performance for at least 2 weeks. The performance of the 4 and 4 was better and recommended for longer periods of 60-90 days in terms of performance efficiency.

A primary consideration in this matter of such close scheduling is the effect on an individual's performance when you interrupt his routine and deprive him of one of his scheduled periods of rest. That is, instead of the duty-rest, duty-rest, duty-rest cycle the man would have a duty-rest, duty-duty, duty-rest cycle.

This type situation might arise in an emergency. How long would it take after this interruption for a man's efficiency to return to the same level that it was before the interruption?

A group of scientists, using one schedule of 4 hours of duty and 4 hours of rest and another schedule of 4 hours of duty and 2 of rest, studied the problem.

They concluded that performance is maintained at a higher level by subjects working 12 hours per day on the 4 hours of duty and 4 hours of rest schedule than by those working 16 hours per day following a schedule of 4

hours of duty and 2 hours of rest. Interference with the rest periods will result in loss of efficiency in both cases, but a sleep loss will affect the performance of those on the 4-hour duty and 2-hour rest schedule more than those on a 4-hour duty and 4-hour rest schedule.

Performance after sleep deprivation will return to normal for the subjects on a 4-4 schedule after 2 periods (8 hours) of sleep. The total time involved would be 12 hours. Those on the 4-2 schedule would need 3 periods (6 hours) of sleep. The total time required would be 14 hours to return them to a performance level equal to that before the period of sleep loss.

Research on sleep continues, and knowledge on the subject increases. Although we cannot say positively how or why a person sleeps, we can state without contradiction that man must sleep. We know that man's sleep and wakefulness occurs in a rhythm that varies with individuals and conditions. Also, without a proper ratio of sleep to wakefulness man's efficiency is reduced.

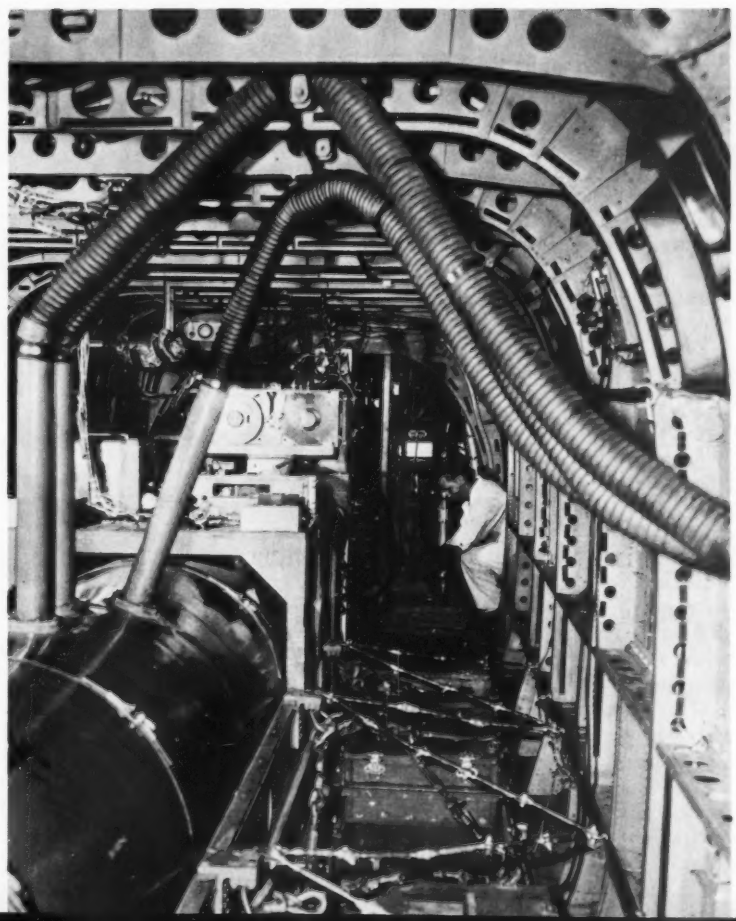
Keep these facts in mind the next time you schedule an aviator for a flight after extended periods with minimum sleep, or when you shake a willing crewchief or mechanic out of the sack to make a delicate adjustment on some part of an aircraft. Under these conditions, your decision may have some lasting influence on the lives and actions of your men.

Chinook Lifts Top Load

A BOEING CH-47B helicopter recently demonstrated its ability to operate at gross weights up to 46,000 pounds. Because of its low empty weight of 19,375 pounds, this means the Chinook is capable of carrying useful payloads up to 25,500 pounds. Both the gross weight and useful payload figures are believed to be records for free world production helicopters. The present authorized operating gross weight for the current production Chinook model is 40,000 pounds.

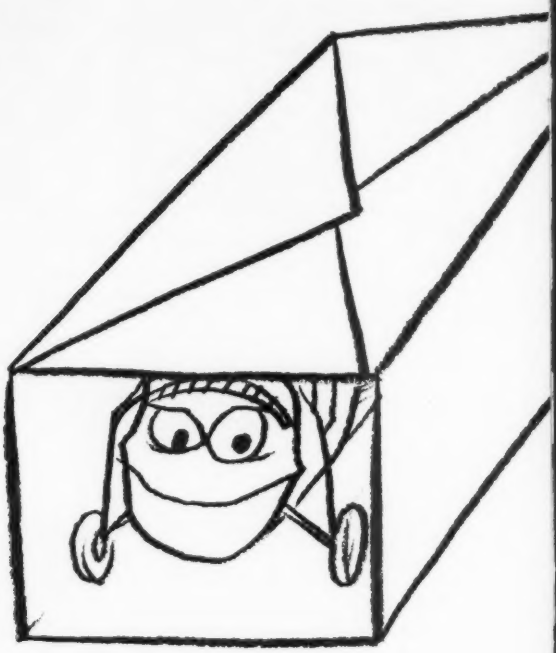
The Chinook performed the following maneuvers at high gross weight: hovering-in-ground effect, left and right turns, climb to service ceiling and standard flight maneuvers at 2,000 and 4,000 feet. Maximum speed achieved was 142 knots. Based on preliminary evaluation of flight data, it appears the gross weight envelope for advanced Chinook helicopters can be increased.

CH-47B model Chinooks are currently in production for the U. S. Army.



AIRCRAFT ENVELOPE SENSE

Major Chester Goolrick



EVERYBODY IN AVIATION circles knows about Murphy's Law. (If it is possible to install a doohickey backwards, somebody is sure to do it.)

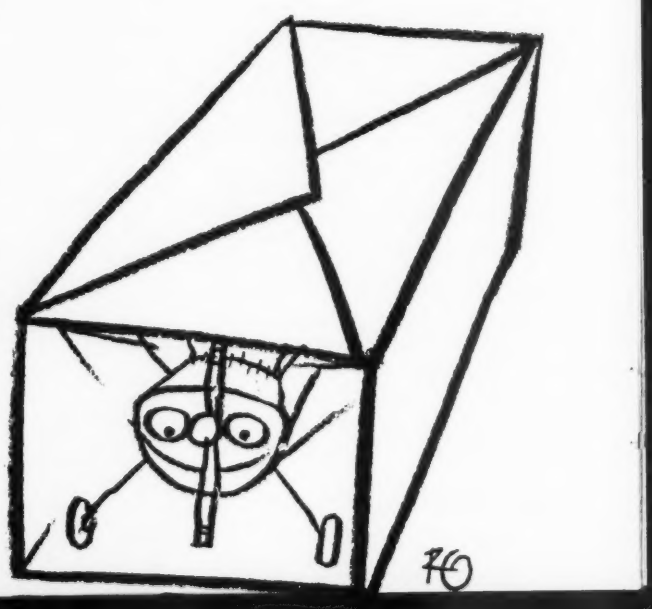
Toy manufacturers have a law all their own, just as infallible, one guaranteed to bring in fat profits every time Christmas rolls around.

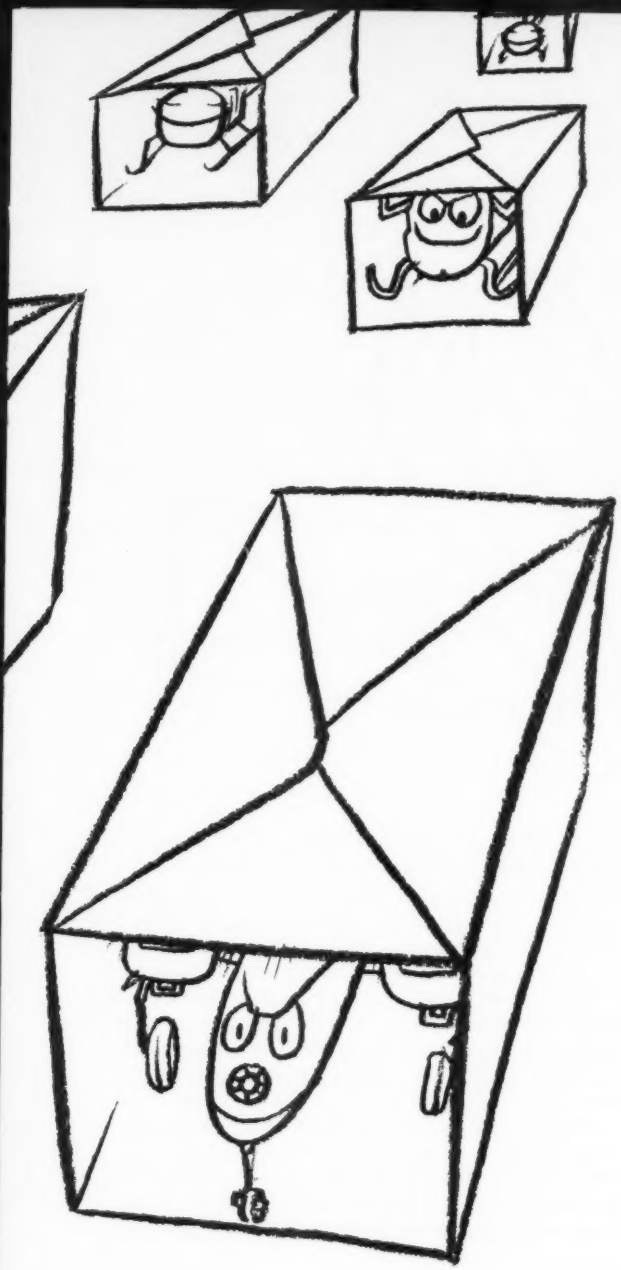
It goes: *If you play with anything long enough, it will break.*

Any parent who has seen Junior work over the shiny new $19.95 toy fire truck Santa put under the tree can appreciate the general idea. By the time Junior is tucked away for the night, full of plum pudding and turkey, good old Hook and Ladder No. 5 is missing a wheel or two, the hood is caved in, the steering gear is no longer functioning, and the whole thing looks as if it had been run over by a tank.

From the toy manufacturers' standpoint, this is fine. They aren't interested in their products' time before overhaul. If he is soft enough in the head — and a fair percentage are — Pop can always cough up an extra $19.95 and produce another engine for Junior to beat on with a hammer. Or he can buy something else equally as breakable. Any way you slice it, the toy people wind up declaring extra dividends and spending the two weeks at Bimini while Pop is down at the office with his nose to the grindstone.

If a toy's longevity *did* mean more cash in the till, you could bet the next $19.95 you got your hands on they would do something about it.





the following 28 pages prepared by the United States Army Board for Aviation Accident Research

For one thing, they'd make Hook and Ladder No. 5 out of something more substantial than material with the strength of a soap bubble.

They might hire somebody like Junior to pound on a sample model with a hammer and drop it out of a window to see how much extreme treatment it *could* take.

They would strengthen the weak points.

And they might send along with each toy a set of instructions telling what it was *supposed* to do, what it *could* do, and what it should never be *asked* to do.

You could call such a document the Hook and Ladder No. 5 envelope.

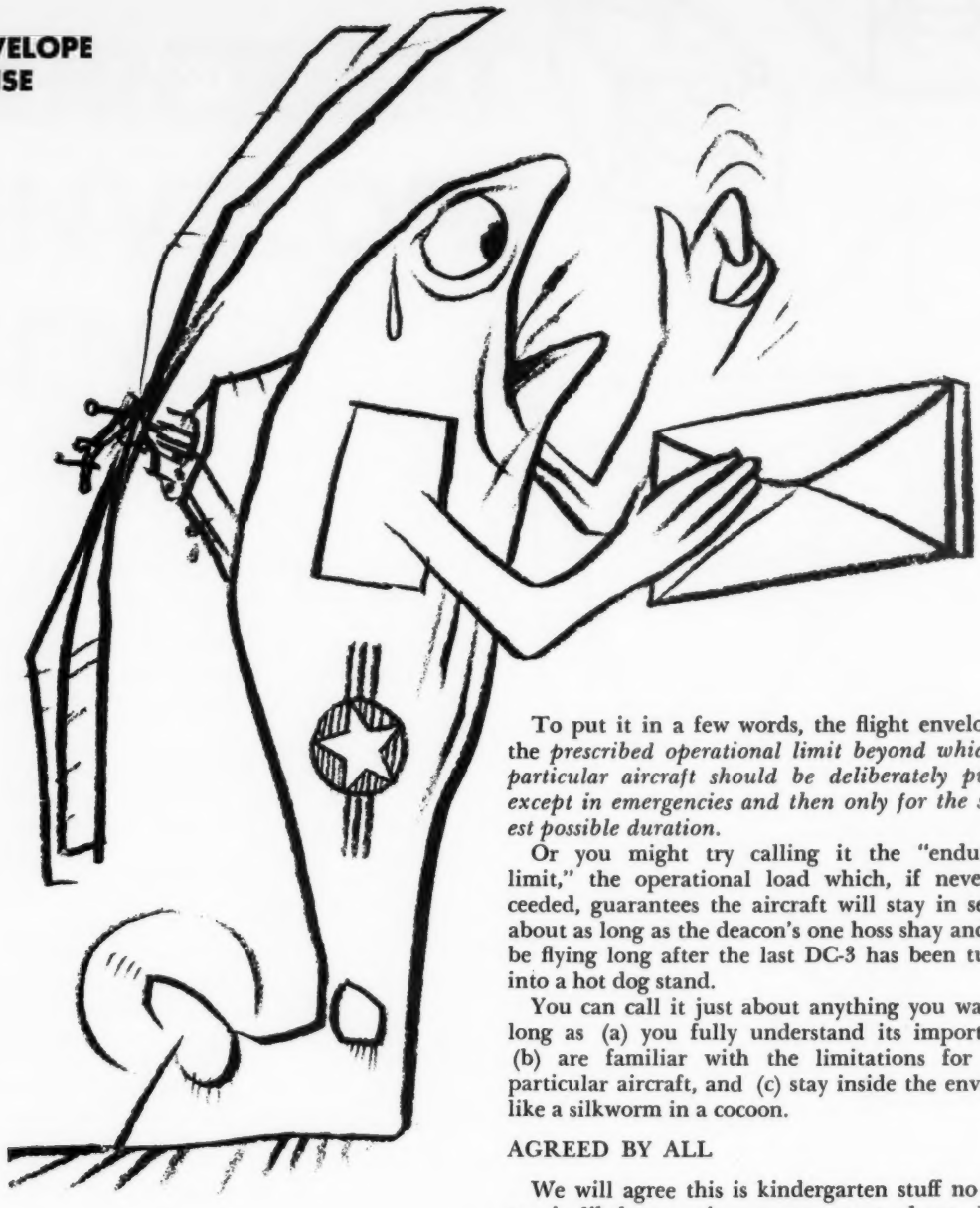
AIR MAIL SPECIAL

Up to a few years ago, if you had asked anybody in Army aviation what was meant by the flight envelope, he would have assured you it was the fastest possible way to get a letter filled with all kinds of slushy phrases to the girl back in East Peoria, Ill. It is still not a bad definition. You might try it next time, instead of saving money on stamps.

In recent years the flight envelope has taken on a more businesslike significance for Army aviators. Today it is a handy—and deadly important—way of getting across the basic idea that an aircraft in the hands of an unthinking aviator, mechanic, or supervisor is in just about the same unhappy fix as Junior's fire engine on Christmas morning.

IF YOU PLAY WITH AN AIRCRAFT LONG ENOUGH IT WILL BREAK, TOO.

ENVELOPE SENSE



in recent years the flight envelope has taken on a more business-like significance for Army aviators . . .

To put it in a few words, the flight envelope is the *prescribed operational limit beyond which no particular aircraft should be deliberately pushed except in emergencies and then only for the shortest possible duration.*

Or you might try calling it the "endurance limit," the operational load which, if never exceeded, guarantees the aircraft will stay in service about as long as the deacon's one hoss shay and will be flying long after the last DC-3 has been turned into a hot dog stand.

You can call it just about anything you want so long as (a) you fully understand its importance, (b) are familiar with the limitations for your particular aircraft, and (c) stay inside the envelope like a silkworm in a cocoon.

AGREED BY ALL

We will agree this is kindergarten stuff no aviator is likely to raise an argument about. It's a known fact that if you abuse any piece of machinery long enough it will wind up as punchy as a fighter who has taken too many right hooks to the head. You learned back in grade school that a paper clip will last forever if you use it as a paper clip (the paper clip envelope). After you have twisted it out of shape and bent it back and forth a few times, you have two pieces of useless wire on your hands.

to put it in a few words, the flight envelope is the prescribed operational limit beyond which no particular aircraft should be deliberately pushed except in emergencies and then only for the shortest possible duration . . .

Agreeing on something and practicing it faithfully as sound, sensible doctrine are two different things, as the chaplain will be glad to explain. There is plenty of evidence — too much — to indicate that aircraft and aircraft components are failing because they have consistently been made to operate outside the envelope. They have been asked to take hurdles they can go over once, twice, or a dozen or more times, but which trip them sooner or later, after enough mechanical fatigue has piled up.

Why should trained aviators who should know what the flight envelope is be guilty of mistreatment of their faithful Bird Dogs and Chinooks? Does Roy Rogers kick Trigger? Does Charlie Brown put Snoopy on half rations? It wouldn't seem humane.

The answer to inhumane treatment of an aviation man's best friend, his trusty aircraft, is woefully simple. Some people have never taken the trouble to gain a sound appreciation of what the flight envelope really is. A good thing, to be sure. Sound doctrine, like visiting your dentist twice a year, but nothing to get in a tizzy about if it is overlooked on occasions when the notion strikes.

People like this are in the same blissful and dangerous state of mind as the chap who lit a match to see if his car's gas tank was empty. "I can't understand it," he told the doctor when he woke

ENVELOPE SENSE

the flight envelope for any aircraft is iron bound; it can be violated, but not for long . . .

up in the hospital. "I've done the same thing many times before and nothing happened."

Ah, so. The real fact is that the flight envelope for any aircraft is a precisely calculated formula arrived at by mathematics, painstaking bench tests, and long hours of practical experience. Sure, it can be exceeded, because for one thing its limits do not represent the point at which the wings tear off or the rotor blades come apart. It has a built-in safety factor, meaning there is a healthy margin between what the envelope says is the practical operating limit and the one at which the aircraft begins to disintegrate into bits and pieces.

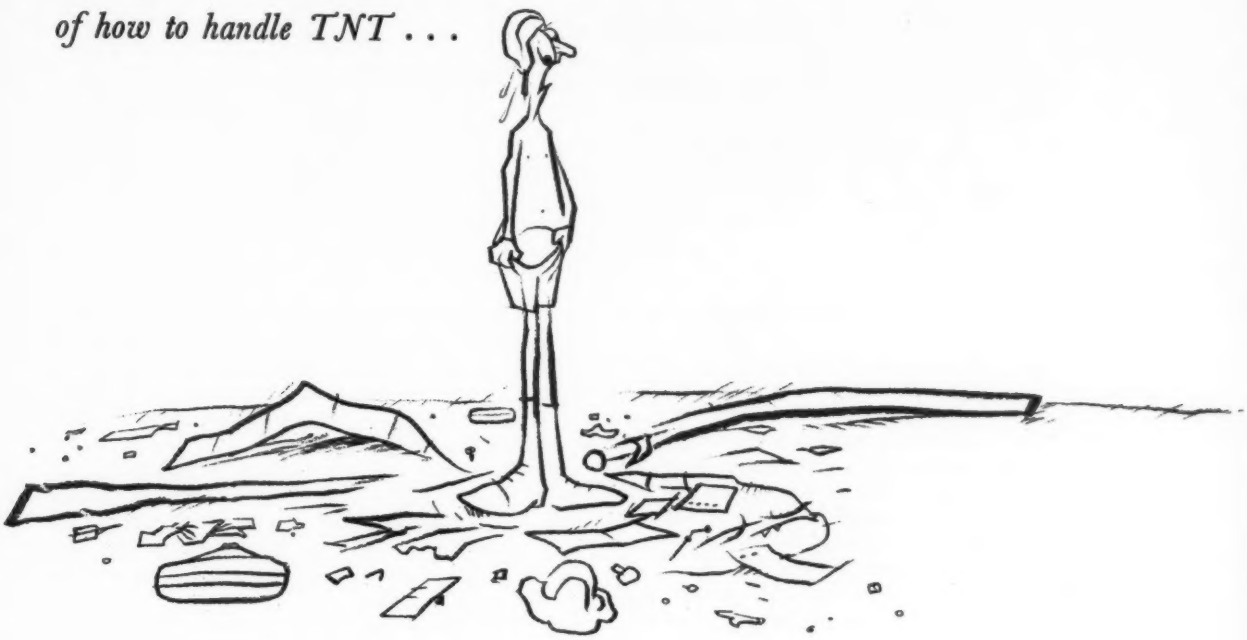
So the flight envelope *can* be violated. But not for long, remember — and never deliberately. It's a law, not a rule-of-thumb. The Big House up the river is packed full of chaps who somehow got the idea that if they could break the law once they could keep it up forever. They are in the same sad shape as the pitcher that went to the well once too often. The fellow who carried it had never boned up on his pitcher envelope.

BLACK AND WHITE

It stands to reason that if you are going to stay within the law, like any respectable, patriotic citizen, you've got to *know* the law, inside and out and backwards and forwards. If you are unaware that the government has stern views on illegal production of booze, you should not be surprised if the "Revenooers" show up some day and haul you off to jail for operating a still.

Ah, so again, and in spades. Let's take the V-n diagram for any aircraft, for instance, which is the true black-and-white statement of the envelope. At first glance it looks like the work of a mad mathematician coked to the eyebrows on LSD. And that is just about all some aviators give it — a first

an imperfect grasp of the V-n diagram can be as explosive as a dim notion of how to handle TNT . . .



glance. Thrown by the lines and arrows shooting off in all directions and terms such as the limit load factor and the ultimate load factor, an already overworked man can put off thorough study of the diagram for a rainy day or, what can be worse, give it a lick and a promise and convince himself he has it nailed down cold.

Either way, some not-so-fine day he is likely to discover he has bought himself a nice mess of Grade A trouble, reduced for quick sale. An imperfect grasp of the V-n diagram can be as potentially explosive as a dim notion of how to do anything else — from handling TNT to trapping skunks. You might be better off not knowing anything at all on the subject. You could at least be overcautious rather than overconfident. And limited knowledge feeds on overconfidence the way the wolf went after Little Red Riding Hood's grandma.

An aviator who has not given his V-n diagram all the attention it deserves is likely to miss one or two simple but basic facts about the whole envelope business. If a pilot tells you he has taken his aircraft up to the red line any number of times and beyond on a few occasions and then goes on to say it doesn't make all that much difference, you can be sure you are talking to a man who has given his V-n diagram the old quick and easy. He hasn't grasped the fact that the red line is a barrier you never deliberately go *beyond* and, what's more, you don't go up *to* unless you have to.

And if he is all that mixed up in his thinking, he may be equally at sea when it comes to a couple of other basic truths which can bring an aircraft's life to an end before it reaches voting age:

• Any aircraft can be flown *faster* than it can be flown *safely*.

• Any aircraft can be taken over the red line without *apparent* damage. Repeated ventures out-

ENVELOPE SENSE

any aircraft can be taken over the red line without apparent damage . . .

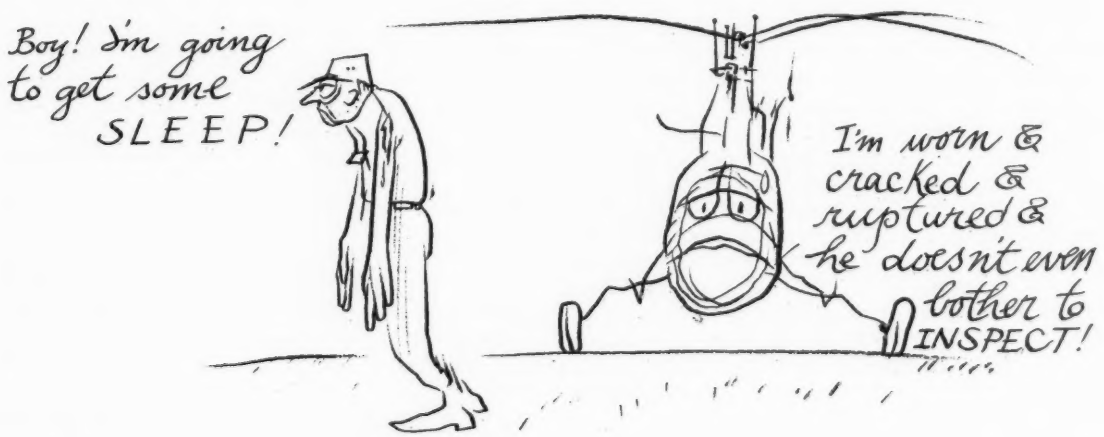
side the envelope *inevitably* lead to failure of a component.

PILE IT ON

The effect of cumulative fatigue on human beings is a fact particularly appreciated by managers of major league baseball clubs. If a manager calls on Lefty Fireball, his ace pitcher, every four days or so, the chances are Lefty will still be serving up his slider when he has reached the ripe old age of 40. If he is asked to start every game he might do fine for the couple of weeks it takes his arm to give way like an overwound watch spring. The .200 hitters start belting his slider out of the park and Fireball winds up back home running a bowling alley.

No manager would ever be nutty enough to overwork a star performer, even if Fireball was dumb enough to go along with the idea. But cumulative fatigue in man or beast can be a lot more subtle. It doesn't hurt you to have a night on the town every now and then and have to do a day's work with only a couple of hours sleep. When you try burning the candle at both ends over an extended period you end up with a case of chronic fatigue and an office performance which makes the boss begin to wonder if you are worth anything like the fat salary he is paying you.

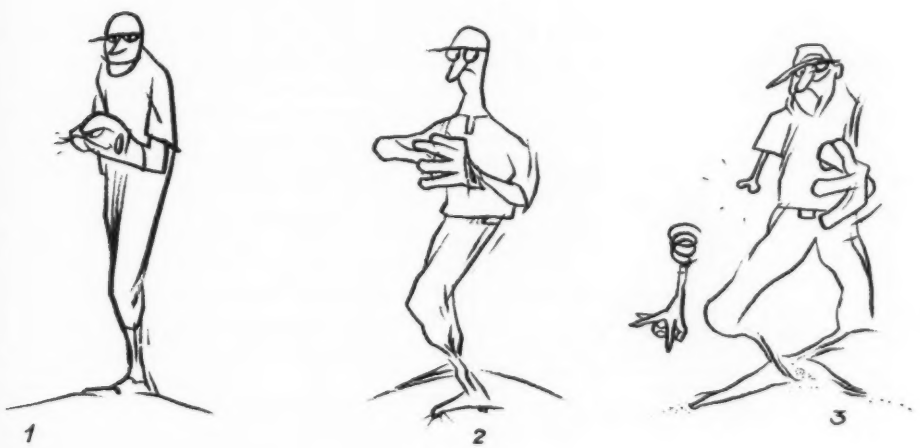
The thing is, most of us can tell when we are bone tired, and most of us have the sense to slow down. This is where the big difference between men and machines lies. An aircraft can get just as tired



as a man, but it hasn't any real way of letting you know. Pushed over the red line repeatedly by a crew which doesn't appreciate the significance of the V-n diagram, an aircraft will keep plugging away like the sturdy soul it is. It keeps plugging away, that is, until one day when some component gives way like Fireball's arm. You can count on it not taking place while you are sitting on the flight line, either. Most likely, the overworked part will give up the ghost while you are so far back in the wilderness the local post office hasn't yet been assigned a zip code.

As anybody with a schoolboy's grasp of physics knows, the reason for the breakdown in such circumstances lies in metal fatigue — premature component senility brought on by a bad case of Envelope Syndrome otherwise known in medical terms as Galloping Abuse. To be sure, *everything* eventually will wear out. Even Old Man Mose is going to kick the bucket one of these days. It is the *when* that constitutes the nitty-gritty bit.

The flight envelope makes the date of a component's retirement on grounds of old age a matter of mathematical predictability. *Every time* the red line is exceeded, the predictability is reduced as creeping fatigue begins to set in. Metallic molecules in a bolt, plate or blade which were lined up like West Point cadets on parade when the aircraft left the factory begin to wilt and wander off in all directions after a certain amount of uncalled for pounding, wrenching or torquing. Like the twisted paper clip, the part under punishment eventually



pushed over the red line repeatedly, some component will give way just like Fireball's arm . . .

ENVELOPE SENSE

turns into something resembling silly putty, about as capable of taking the load it was designed for as a pound of Swiss cheese. The result — one downed aircraft with a pilot beginning to wonder if he remembered to bring along his survival gear.

Chances are good, also, that the luckless man down back in the bushes might be innocent of the crime that brought on the component failure. An unnoticed pinprick or a bite by a bug you could hardly see with a magnifying glass can lay you low in the isolation ward weeks later. Pilots have been known to inherit aircraft with unreported medical histories which should by rights have redlined them for overhaul. When something gives way, the pilot can't be blamed if he thinks fate handed him a raw deal.

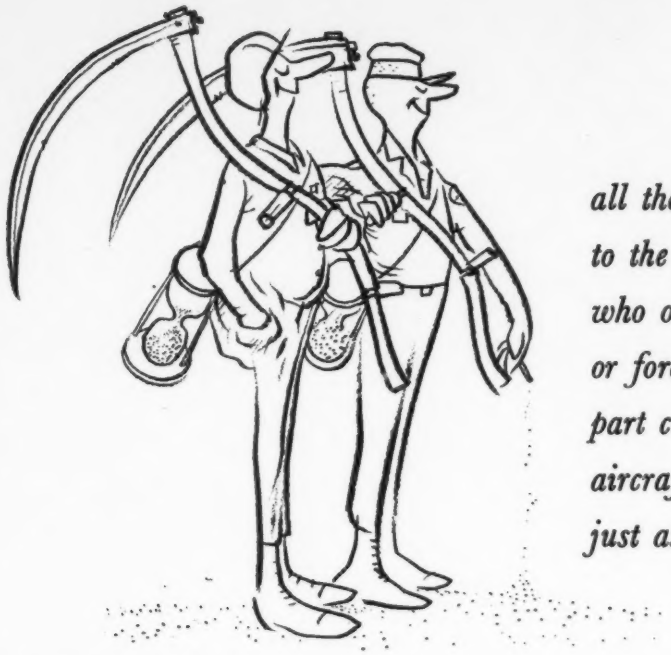
There was the case of the Chickasaw which crashed when the red blade parted in the direction of flight, causing the transmission and mast to shift aft and things to come apart generally. The poor fellow at the controls thought he was in charge of a healthy piece of machinery. In truth it was at death's door because of a recent history of hard landings and lateral vibrations, and the rotor head had been hit by a bird big enough to carry off a bull moose. By rights, the aircraft should have been in the hospital having its temperature taken.

Another case, involving a fixed wing, came when the undercarriage collapsed following a smooth landing. It turned out that sometime previously another crew had landed hard on the terrace short of the runway after a flareout and had made only a visual inspection from within the aircraft before taking off. They had to be recalled to report the cause factor they had set up in a chain of circumstances which cost a nice, round 30,000 clams.

Failure to report incidents of this kind is a good, if depressing, example of the lack of a full appreciation of the envelope's significance on the part of some aviators — bought by the idea that an aircraft is virtually indestructible. Let's have a look at the sturdy Seminole. Regulations say that 48 inches of manifold pressure is allowable at sea level and that, as density altitude increases, pressure should be reduced. OK, so what happens when a pilot takes off near sea level pulling 48 inches when the DA is nearer 1,200 feet? The Seminole winds up with a cracked cylinder after a while, that's what.

Don't blame it all on the poor pilots, either. A mechanic who overtorques a bolt or forces an unwilling part, inadequate maintenance inspections, and supervision can bring an aircraft to grief just as effectively.

Component fatigue plays no favorites. Just about anybody can get into the act.



all the blame doesn't belong to the pilots . . . a mechanic who overtorques a bolt or forces an unwilling part can bring an aircraft to grief just as effectively . . .

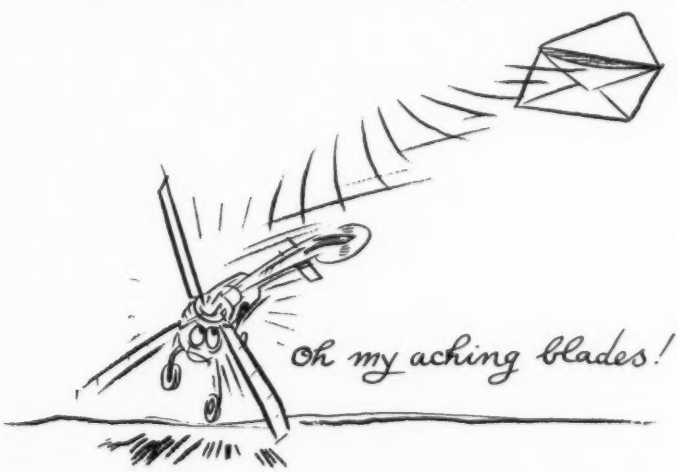
VARIETY SHOW

There is one thing to be said about metal fatigue. It takes a little time to build up. If you are the impatient type and have enough imagination, there are plenty of other ways to violate the flight envelope and accomplish the same results in a hurry. In one fell swoop, you might say. For instance, a helicopter pilot flying fast and low recently entered a 60° left bank for a turn of 100°. He leveled off, then resumed his bank and crashed after a turn of 120°.

Why? If he had studied his V-n diagram for his type of aircraft he would have known that, loaded as he was, he couldn't make a safe recovery under 100 feet. Our late friend proved the point.

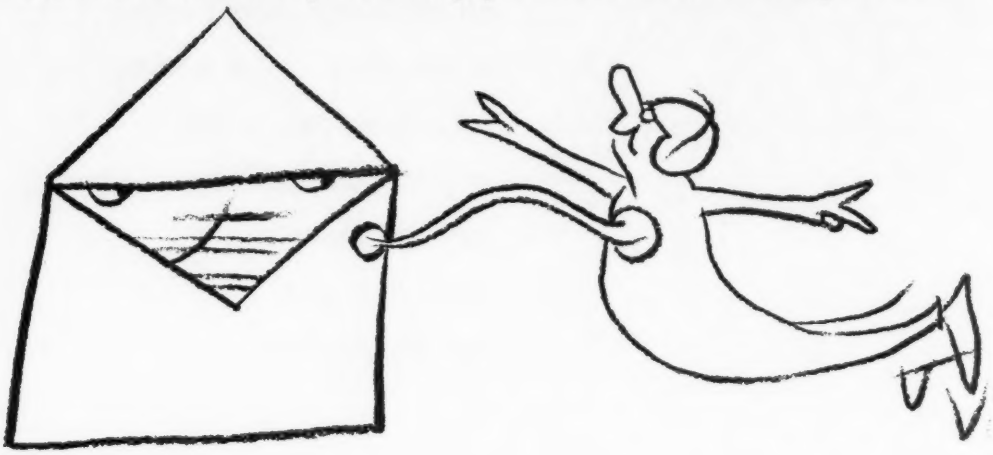
We can be thankful that not all envelope violations are so spectacular, or so violent. The point is that when you are outside the envelope you are in dangerous territory, set with more hidden traps than you are likely to run into outside the Mekong Delta. And when you are nailed by one it is usually too late to do anything about it.

Want a milder example? How about the Bird Dog pilot who tried to make a 360° overhead ap-



ENVELOPE SENSE

When you are out of the envelope you're in dangerous territory, set with more hidden traps than any place outside the Mekong Delta



proach with 60° flaps? He initiated his approach at 600 feet, lowered his flaps, reduced power to idle, and started his turn. At 180° he realized he would be long and extended his turn. So far, so good. At 25 feet, still high and still long, he tried to reduce his speed by raising his nose. He stalled in and collapsed his gear.

The moral to this one-act drama? The Bird Dog's flaps, as our hero should have considered, are designed for short strips. At 60° nose high, and with no power, a stall is inevitable. You might as well try to get out of next year's income taxes.

When something like this happens, there is a temptation to brush it off by saying the pilot lacked experience. It's a good enough excuse, as excuses go. It is a pity to have to report that as often as not it doesn't happen to be so. It is a sad fact that greybeards are just as good at getting outside the envelope as tenderfeet.

Maybe even a little better, in fact. When you are

the veteran might be a tad less cautious about the flight envelope than the rookie . . .

. . . flying out of the envelope is a case of the pilot failing the aircraft, instead of the other way around . . .

in school, you are programed to follow certain standard procedures designed in part to keep you within the envelope. Once you are out of school and have accumulated enough hours to enter the danger zone where overconfidence sets in, you can be tempted to succumb to the temptation to boot an aircraft along at full bore, take it down as fast as it will go, or violate other rules of standard flying. But it stands to reason that if an aircraft can't be made to do something, anymore than an elephant can be taught to pole vault, it doesn't much matter whether the man at the controls has 5 or 5,000 hours behind him. It is a case of the pilot failing the aircraft, instead of the other way around.

It is also possible that the veteran might be a tad less careful about the variables which affect the flight envelope than the super-cautious rookie. Violation of the c.g. limits prescribed in the -10, for instance, and here is a very tricky area indeed.

Suppose a pilot lets an OH-13 mechanic put his toolbox at his feet. Nothing to get in a flap over? He may shift the c.g. just enough to make the pilot unable to stop his forward movement. Any red-blooded pilot will agree that there should be a constitutional guarantee that he can bring his forward movement to a halt when the occasion calls for it.

The c.g. limitations are closely tied in with the whole business of weight and balance. When you add it all together you have a proposition on your hands about as delicate as an undernourished butterfly. Here is one situation in which a bad guess is no better than no guess at all, another instance where an experienced but careless pilot can make a hasty estimate and set up a chain of circumstances which costs him the ball game.

Just about everything went wrong for a hapless Iroquois pilot one Black Friday when he tried to slingload four 55-gallon drums of JP-4 a half mile

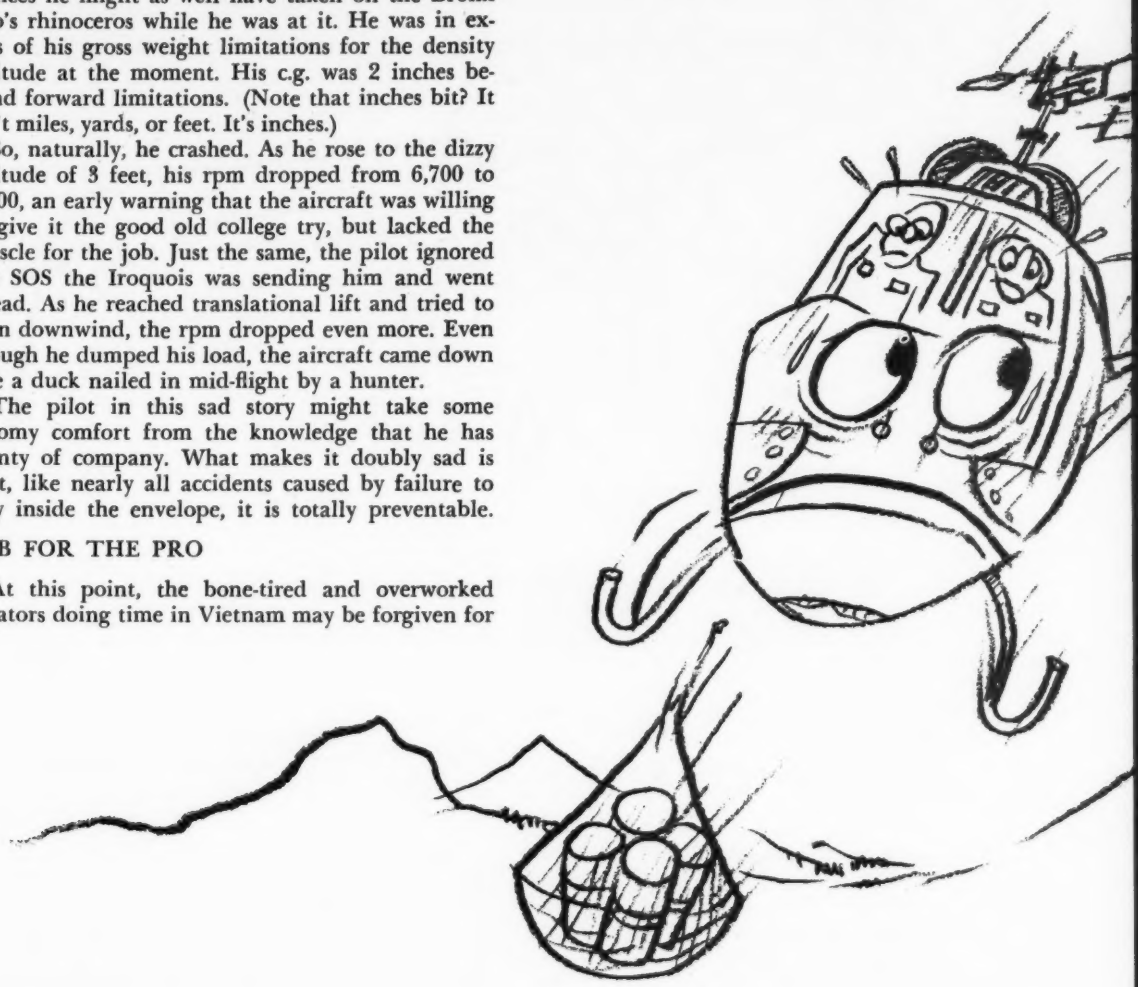
to the rear of his unit's position. Under the circumstances he might as well have taken on the Bronx Zoo's rhinoceros while he was at it. He was in excess of his gross weight limitations for the density altitude at the moment. His c.g. was 2 inches beyond forward limitations. (Note that inches bit? It isn't miles, yards, or feet. It's inches.)

So, naturally, he crashed. As he rose to the dizzy altitude of 3 feet, his rpm dropped from 6,700 to 6,400, an early warning that the aircraft was willing to give it the good old college try, but lacked the muscle for the job. Just the same, the pilot ignored the SOS the Iroquois was sending him and went ahead. As he reached translational lift and tried to turn downwind, the rpm dropped even more. Even though he dumped his load, the aircraft came down like a duck nailed in mid-flight by a hunter.

The pilot in this sad story might take some gloomy comfort from the knowledge that he has plenty of company. What makes it doubly sad is that, like nearly all accidents caused by failure to stay inside the envelope, it is totally preventable.

JOB FOR THE PRO

At this point, the bone-tired and overworked aviators doing time in Vietnam may be forgiven for uttering a hollow and mirthless laugh and inviting people who lecture them on the flight envelope to go soak their heads. They don't have to be told the envelope for their aircraft over there fits them tighter than the bathing suit on the California entry in the Miss America contest. They know that life expectancy for their rotor blades is just about halved because of the dust, which is what Vietnam is largely constructed of when it isn't being mud. They could tell you a thing or two about dirty or unsettled fuel.



All too true. In the field, and particularly in combat, operating conditions can be, and usually are, rugged indeed. About the only thing to be said is that within practical limits all concerned should do their level best to stay under the red line and to note and carefully report every time it is passed. Combat or no combat, a cracked cylinder is a cracked cylinder. A Chinook taking off with a gross overload in high density altitude isn't going to lift one more pound in Vietnam than it will at Rucker. A sick aircraft is of about as much operational

value in combat as it would be parked in a childrens' playground.

Under normal conditions there is never any excuse for going outside the envelope, except in emergencies. To put it fair and square, the man who does it, no matter what his capacity in aviation, simply isn't a professional. He's the kind who reasons that since the aircraft can fly much faster than the envelope stipulates, he might as well make it do all it can. Or he might not see the point in always being so blooming fussy about proper shutdown procedures. If he is a mechanic, he may sometimes overtorque a bolt or force an unwilling part. In another capacity he may be sloppy about supervisory or inspection standards. Whatever his job may be in Army aviation, he is a junior grade thinker in a profession that calls for graduate school brains.

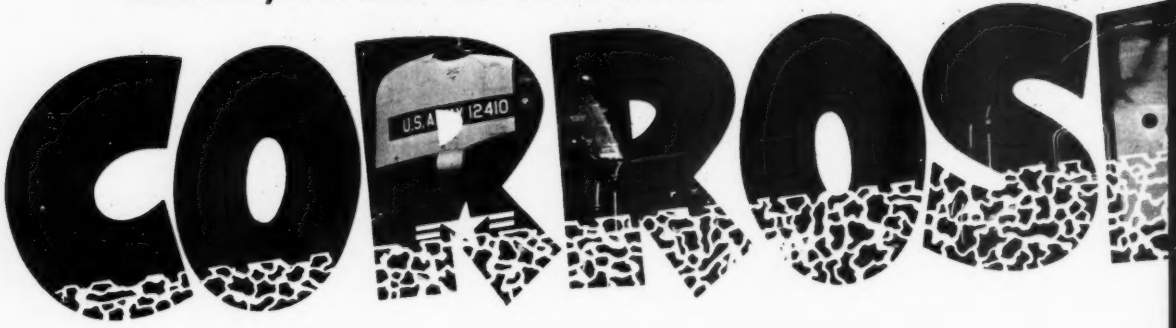
The envelope can be the useful tool the manufacturers intended it to be only when mature aviators understand it, exercise personal restraint, and then approach their jobs with a truly professional attitude. When they are working with a new or experimental aircraft they are *doubly* cautious because experience occasionally shows the need for redesign of a dynamic component. They always record the times when they are forced outside the envelope, aware of the cumulative effect, knowing when they pass the red line they can be banking trouble for some other poor soul to draw interest on. They are in a man's world. They never forget it.

One way to keep it in mind is by recalling the example of old Abou Ben Adhem.

Old Ben may have loved his fellow man, as the poem has it, but he sure didn't know much about camels. Ben was the original chap who piled that last straw on the camel's back.

Ben had never heard of the camel envelope.

With good preventive maintenance techniques and an effective corrosion control program, deficiencies caused by corrosion can be controlled . . .



RUST, TARNISH, galvanic corrosion, stress corrosion cracking, intergranular corrosion are terms that should be of concern to all aviation personnel. The high cost of parts, labor, aircraft downtime, and component failures demands that we use every means at our disposal to prevent material waste due to corrosion. Corrosion of metals is probably the greatest waste or cause for replacement of aircraft components and structure. No aircraft or no component seems to be immune to its attack.

To try to clearly define these would be almost as difficult as defining time. To eliminate them would be even more difficult. But to reduce their propagation and resultant damage to Army aircraft structure and components is definitely possible. In this article I hope to effectively explain the electrochemical interaction that causes corrosion, describe common types of corrosion experienced on Army aircraft, explain certain techniques for treating and controlling it, and provide general requirements for a corrosion control program maintenance personnel can implement that will assist in reducing corrosion problems.

All metals are affected to some extent by the atmosphere, the sea, sulfuric acid, and that humanistic acidic liquid that emanates from a most important aircraft component, the relief tube. This effect or chemical reaction of a metal or metal alloy with its environment is called corrosion, and it must be controlled on aircraft components and structures.

The three most active agents in the corrosion of metals are water, oxygen, and carbon dioxide. All of these exist as particles or gases in the air, with the latter two also found dissolved in water that comes in contact with metals. In addition, small and varying amounts of other gases, such as ammonia, oxides of nitrogen, hydrogen sulfide, and sulfur dioxide, get into the air and water and share in the rusting, tarnishing, corroding and destruction of metals. Corrosion is a complicated process in which several destructive agents can be acting at the same time on the base metal.

Let's now take a look at the basic electrochemical reaction that takes place in most types of corrosion and see how it can be controlled. Since corrosion consists of an electrochemical reaction similar to the reactions taking place in a common dry cell, an explanation of the electrochemical reaction in such a dry cell (common flashlight battery) appropriately explains the chemical and electrical actions that have taken place in metals with corroded surfaces.

Take such a flashlight battery and cut the cylin-

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Directorate of Research
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...ITS CAUSES AND CURES

drical shaped surface at its center into two pieces. Looking at the cut cross-section, you will see a hard pin in the center about a quarter of an inch in diameter which is nothing but a stick of carbon and is identified as the carbon (cathode or positive pole) electrode. Poke around the edge of the cut and you will discover a hard cylindrical ring which shapes the battery and is generally made of zinc. This ring is identified as the zinc (anode or negative pole) electrode.

When current is impressed on a cell from an external source, as in electroplating, reduction occurs at the electrode connected to the negative pole of the external source, and this electrode consequently is the cathode. In between the zinc and carbon electrodes you will find a soft pliable black material (this material is the electrolyte of the battery and becomes hard in a dead cell). This electrolyte is usually an ammonium chloride (NH_4CL) solution.

During an electrochemical reaction (while your flashlight is turned on) a chemical and electrical reaction takes place. Electron current flows from the zinc (anodic pole) to the carbon (cathodic pole) through the flashlight bulb circuit. To develop this current, a chemical reaction occurs in the dry cell. The zinc (anodic pole) is eaten up or destroyed as the dry cell is operated. This we call oxidation. Reduction takes place at the carbon (cathodic pole), where current is collected from the electrolyte.

This process of dissolving the zinc pole and causing a reduction at the carbon pole is similar to the electrochemical process that occurs in corrosion. Any metal surface can have such an electrochemical reaction by simply having a composite of dissimilar electrodes (impurities in the metal or on its surface) short circuited through the body of the base metal by gases, water, impurities, etc. But as long as the base metal remains dry (no electrolyte present), local electrochemical reactions that cause corrosion can be minimized. Experiments of corrosion effects on metals in hot, humid climates have proved this to be true.

The next question is, How do we stop these electrochemical reactions that cause corrosions? We can use the flashlight battery analysis as an example. The electrochemical reactions can be stopped by simply opening the electrochemical circuit so that the process of oxidation of the zinc ring and the reduction of the carbon rod can be stopped. On aircraft metal surfaces, we open a similar circuit by interposing an insulator between the two electrodes, the base metal and its environment (water, etc.), a protective substance inert to both the base metal and its environment. This protection can be a very thin film of paint, metallic coating, organic

CORROSION

coating, or other inorganic types of adhesive protectors.

The drawings show a simplified version of what happens during an electrochemical reaction on the surface of metals that causes corrosion. This corrosion could be pitting, fretting, flaking, etc. They also show what happens to the circuit when you place a protective chemically inert material between the base metal and its environment. However, any protection suffers from one main drawback — no matter how fully applied coatings may be, gaps caused by scratches, flaws, etc., will either exist or develop. This undermines the protective coating and initiates the electrochemical process, thus rendering the protection inefficient or useless.

Basically, two distinct types of corrosion are experienced on Army aircraft. The first type is the eating away, pitting or fretting of metal surfaces as explained above. This is called direct surface corrosion and is caused by a direct chemical reaction with an aqueous solution, oxygen or carbon dioxide. Another form of direct surface corrosion is that caused when two dissimilar metals of different activity are electrically coupled by direct contact, or contact is made by a continuous liquid or gas path. This type of direct surface corrosion is called galvanic corrosion.

The second type of corrosion is very dangerous and almost impossible for field maintenance personnel to control. It is called intergranular or intercrystalline corrosion, since the electrochemical reaction actually takes place internally between impurities in the metal anodic and cathodic crystalline or granular structure. Such corrosion results from a lack of uniformity in the alloy structure, usually caused by improper heat treatment and/or quenching.

For steels, the most common impurities that cause intergranular corrosion are precipitated carbides. For aluminum alloys, the most common impurities are copper and zinc particles coupled with hydrogen. Improper quenching of an aluminum alloy results in a depletion of copper in the alloy, which accounts for the anodic electrodes in the grains, making the alloy a marked candidate for intergranular corrosion.

Methods are being developed to detect intergranular corrosion by the use of ultrasonic and eddy currents. Until such methods are available, magnaflux is the only general method in use.

Direct surface and intergranular corrosion has been tagged with many names. Some of these are:

Galvanic corrosion
Dissimilar metal corrosion
Pitting corrosion
Intergranular corrosion
Intercrystalline corrosion
Fretting corrosion
Stress corrosion
Fatigue corrosion
Urinistic acidic corrosion

All of these require an electrochemical reaction with a cathodic and anodic electrode, with some type of electrolyte.

To discuss techniques for treating and controlling corrosion, as well as developing an effective corrosion control program, a general survey was made of Army aircraft reported deficiencies or component failures due to corrosion. The following represent the most common types of deficiencies:

Tee cap stripping was corroded. Pits extended through the tee cap material leaving holes 1/16 inch and larger (pits) which seriously weakened the aircraft structure.

Upon inspection of assemblies before installation on aircraft, new and overhauled assemblies were found corroded upon removal from storage containers. Water was found in some containers. Recommend close supervision of preservation, packing and storage procedures.

Upon inspection of fuel cells removed from aircraft undergoing depot repair bonding, separation and corrosion was observed between aluminum sump fitting and fuel cell. Indications were that leakage was caused by corrosion induced by the collection of contaminated water in fuel cell cavity.

Transmission was received corroded internally because no preservative oil was in the case. Recom-

mend that such high dollar components be preserved before shipment.

Transmission was corroded beyond limits in the area around case bolts. Transmission was replaced.

During periodic inspection of aircraft, water was found in all antenna supports with corrosion caused by water standing in the supports. Recommend that a small drain hole be drilled in the lower portion of the support structure to allow moisture and water to escape.

Magnesium flooring and cargo tie-down beams were found to be severely corroded at 600 hour inspection. Recommend use of aluminum instead of magnesium for flooring and beam structure.

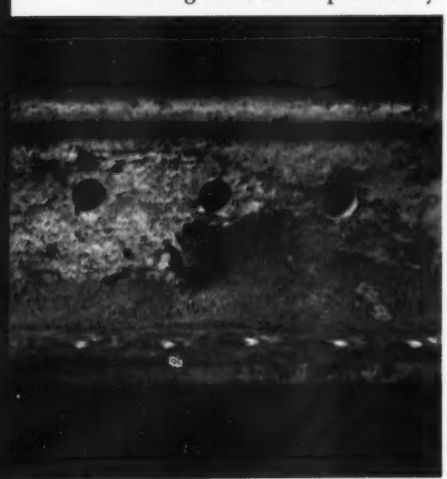
Improper sealing between dissimilar metals caused excessive corrosion which weakened tie-down fittings. Recommend use of aluminum in adaptor fittings.

Bellcrank assembly controls corroded around sleeve bushings in area near washer and attaching areas of the vibration damper arm. Suspect cause of corrosion contact by dissimilar metals.

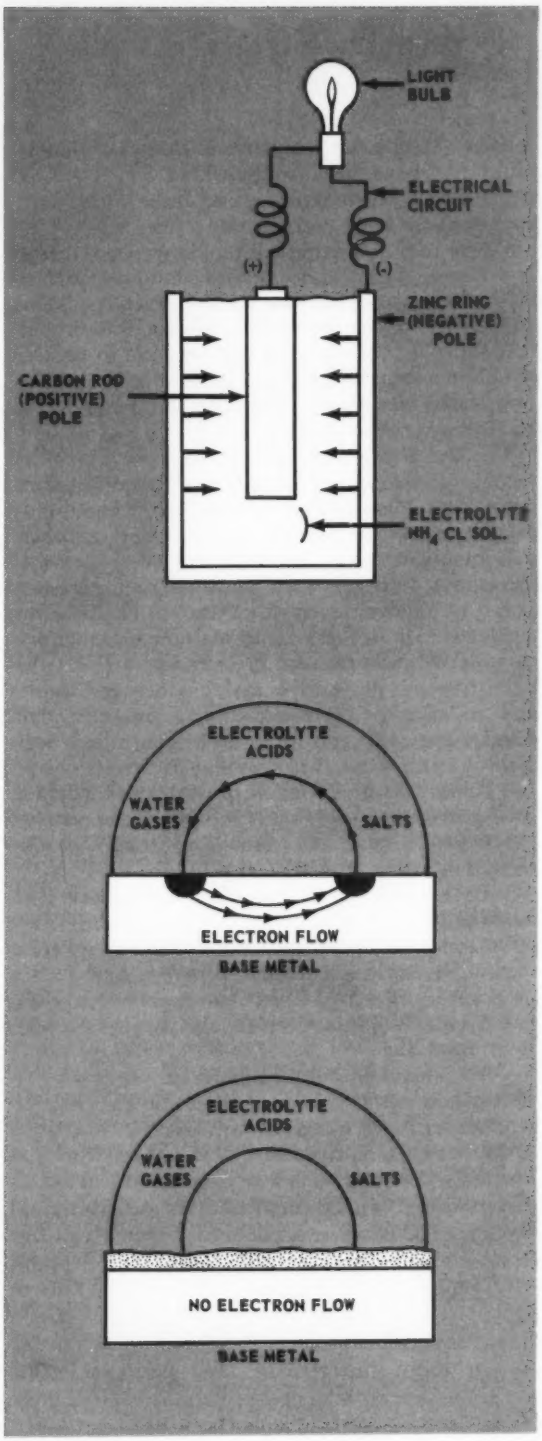
Plated bolts throughout aircraft were badly corroded. Plating appeared to be very thin and porous, and contained scratches. Recommend dipping bolts in oil before installation.

Machine bolts removed from aircraft were found to be excessively pitted and rusted because of exposure to high humidity and salt air. Recommend all machine bolts be replaced with corrosion resisting bolts.

Corrosion present in and around bolt holes on the face of the cap assembly. Corrosion started under paint because metal was not properly treated. New drive shaft and cap assembly requisitioned as a replacement when corrosion was discovered after uncrating drive and cap assembly.



Part from Army airplane wing shows effects of intergranular corrosion



CORROSION

Even though the majority of these deficiencies could not have been corrected at organizational level, certain temporary repair techniques could have contained the corrosion at a level that would not have required extensive repairs when returned to a depot. Temporary repair techniques, such as paint touchup or the use of preservatives is frequently the only prevention available. The important thing is that whatever can be done to contain or eliminate corrosion should be done at the earliest practicable moment to minimize the continuation and spread of deterioration.

The first action necessary to make any temporary repair is to determine the extent of corrosion damage and the damage done on primary structure or components of the aircraft. If it can be determined that highly stressed (primary structure) areas of the aircraft have not been damaged, then necessary action to remove the corrosion should be taken immediately. Applicable aircraft maintenance manuals contain corrosion removal procedures.

With good preventive maintenance techniques and an effective corrosion control program, deficiencies caused by corrosion can be controlled. Such control techniques and treatment involve:

A concentrated inspection program for detection.

Cleaning and stripping of the corroded products.

Neutralization of any residual materials that may remain in pitted or crevice areas.

Early replacement of permanent protective coatings and paint finishes.

Corrosion is a very real problem that requires a continuous corrosion control program. But such a program is different for each environment and different aircraft system, even though they all include, as a minimum:

• An adequate cleaning program. In corrosion control, the term "clean" means to do the best job possible with the materials and facilities available. A wipedown with a water or oil soaked cloth followed by a wiping with a dry clean cloth is better than nothing. Critical components of aircraft should be cleaned as often as possible to keep surfaces free from salt, soil, water, and other corrosive deposits.

• Detailed inspection for corrosion and failure of protective systems. Except for certain special inspections, inspection for corrosion should be a part of routine daily, intermediate, and periodic inspections. But corrosion inspection requires a little more effort than kicking a tire to check its air pressure. There are advantages to assigning corrosion inspection and corrective action to a special maintenance group or crew. By doing so, more emphasis can be placed on the corrosion discovered.

• Daily servicing requirements for corrosion prevention (draining fuel sumps, draining known trapped areas on aircraft, etc.). Critical surfaces of aircraft components which remain bare of paint or other protective finishes should be wiped down on a daily basis. For example, main rotor hub scissor fittings, main rotor blades, tail rotors, and hubs all could be listed as aircraft components with critical surfaces.

• Ground handling and proper use of covers. Little techniques such as heading the aircraft into the wind during dust and rain storms and installing available covers or canopies to reduce water, salt spray, and dirt from getting on aircraft surfaces can save a tremendous amount of maintenance work later. The rules for protection of idle aircraft are well established and have been demonstrated to be adequate to prevent deterioration under most storage conditions.

• Maintenance of drain holes to assure freedom from obstructions. Most helicopters have drain holes in their tail booms and other fuselage structures. These holes are easily blocked with dirt, grease, loose fasteners, paper, etc. The drains should be checked daily and, when one is found clogged, a thorough inspection of the adjacent area should be made to ensure that corrosion has not started. For better insurance, a thorough wipedown of the area is advisable. If adequate drain holes aren't provided, remove screws or fasteners and drain the area, but do not forget to replace the fasteners. If a drain hole is needed, keep in mind the structural requirements of the structure before drilling such a hole. National maintenance point or contractor field personnel should be contacted as necessary to determine correct size and hole location in structure.

A corrosion prevention program does take time, but the longer you wait to neutralize corrosion damage, the longer it will take to release an aircraft from maintenance after it is red-tagged for repair. All kinds of solvents and protective materials are discussed in maintenance publications that can be used for cleaning and corrosion protection. When such niceties and books are not available, a good washdown and cleaning afterwards with a clean dry rag on a daily basis will be useful. Also, after you have given your aircraft a good bath, look behind its ears for dirt or water. Trapped areas wiped out after such a washdown will help. Moisture in inaccessible areas should be blown out with compressed air.

. . . excellent examples of accident reports submitted by Army flight surgeons . . .

A VITAL MEMBER of every aircraft accident investigation board, the flight surgeon applies his skills and knowledge to human cause factors, injury causation, and prevention. In keeping with the medical theme for this issue of the DIGEST, following are some recent excellent examples of accident reports submitted by Army flight surgeons Accident 1:

A UH-1B was on a night training mission when the pilot became disoriented and made an approach to an open field 900 meters short of the designated LZ. The helicopter hit a wire 36 feet above the ground, traveled 339 feet, then hit the ground in a left nose-low attitude and rolled over to the right. Though the aircraft was destroyed, both occupants escaped with minor injuries.

Flight surgeon: "This accident resulted from the pilot allowing his aircraft to descend to such a low altitude that contact with a power line occurred, with subsequent loss of control and a resulting crash. The final crash was merely the culmination of a series of interrelated events. None of these, in themselves, caused the accident, but when examined in a sequential manner, an accident was the inevitable conclusion. . . .

"It is suspected that a training factor existed in that the pilot lacked recent night flying experience. An examination of his flight records showed only 30 minutes of night flying during the previous four months. . . . By itself, this is not a factor, but it may have been the first adverse factor in the chain of events which led to the accident.

"It is suspected that a communication problem contributed to the accident in that radio contact with the LZ could not be established. Why radio contact could not be made has not been definitely determined and is not in the flight surgeon's area of competence. I can only state that during my examination of the wreckage, the FM radio was set at 49.5, while the LZ frequency was 49.6. It cannot be definitely established that this erroneous setting was used during the flight. However, I believe it can be stated with some certainty that if radio contact could have been made between the aircraft and LZ, an accident probably would have been averted. This is a definite contributing factor in the chain of events leading to the accident.

"It is suspected that environmental factors contributed to the accident. The moon was nearly full and the excellent night visibility may have contributed to overconfidence. . . .

". . . The most pertinent contributing factor to this accident is the fact, by the pilot's admission, that he became disoriented and set up a landing

the flight surgeon

. . . a vital member of every aircraft accident investigation board, the flight surgeon applies his skills and knowledge to human cause factors, injury causation and prevention . . .

approach to the wrong field. It appears that in setting up his approach to the LZ, he was too far out and, as he approached the LZ, he continually lost altitude. He reached a point on final, roughly one mile from the LZ, at such a low altitude that he lost sight of the LZ because of an interposing rise in terrain. At this point, he assumed that the aircraft leaving the LZ had blown out the smudge pots. In reality, he had descended behind the rise in terrain and his line of vision to the LZ was blocked. It was at this point that he became disoriented to the area and set up a landing approach to a field one-half mile short of the LZ. This final situation led to the wire strike and crash. . . .

"Why the above sequence of events occurred can never be definitely established. The pilot failed to follow standard operating procedures by attempting a landing despite the fact that no radio or visual contact was made with the LZ. Why he elected to land, despite orders to the contrary, is open to conjecture. Such factors as psychological conditioning, training, preoccupation with mission completion, excessive motivation to succeed, and overconfidence must be considered. Is this man a potentially hazardous pilot because of his apparent inability to follow directions, or is he the type of man which is needed in combat to exert that extra effort of motivation to complete the mission in the face of potential danger? I can't answer these questions.

"It is suspected that the increased visibility of the moonlight night may have created a feeling of overconfidence in the individual and may have created a condition in his mind of complacency and inattention. Such factors can only be suspected. In this respect, the copilot may have been lulled into the same complacency. It is strongly suspected that the copilot had his head in the cockpit too much during the last few critical moments. . . .

"This accident was considered nonsurvivable for both the pilot and copilot, based on aircraft deformation, cockpit collapse, shattering, and disintegration. The inhabitable seat cockpit area was rotated through many different positions during the crash-deformation sequence because of the collapsing and tearing of the aircraft structure. It was only through fortuitous circumstances that the disintegrating aircraft structures and the inhabitable cockpit area weren't in the same place at the same time.

"The seats partially failed due to the fact that the flooring around the seats buckled and tore. The seat moorings themselves, and the seat belt rings did not fail.

"Both occupants were amnesic for the event, but recall unbuckling themselves from the seats. To this

extent, the seat belts and shoulder harnesses worked and retained the individuals in their seats. To state that this was a factor in their survival is difficult to say. Obviously, in this accident, they fared better by remaining in their seats. No definite conclusion can be drawn from this accident as to future equipment design because of the nature of the accident. Both occupants extricated themselves from the aircraft and walked to the edge of the field, where rescue personnel arrived shortly.

"A fire occurred around the engine area. The aircraft was lying upside down and fuel from the tank fed the fire by gravitation. The fire spread to the cockpit area after two minutes and the left seat was partially burned. The fire was extinguished rather easily with dirt, and portions of the aircraft were spared. However, if the occupants had been unable to evacuate the aircraft, both would have received fatal burns.

"The helmets were retained and gloves were worn. One helmet was left close enough to the wreckage to be burned. The other helmet showed no signs of abrasion. The facial lacerations which both men received probably were from shattering plexiglass.

"The decelerative forces encountered in the crash sequence can only be estimated. The aircraft struck the top wire which was about 35 feet high. The nose pitched up and it is estimated the altitude reached was 50-60 feet. The distance from the wire to the first impact point was about 339 feet. From this, the impact angle was calculated to be 10°. The rate of descent was estimated to be 40 knots. From this, the vertical velocity of 15 feet/second and the horizontal velocity was 70 feet/second. The aircraft dug a furrow about 4 feet long and 4 inches deep, and it was estimated the aircraft deformation added another 2 feet in a horizontal direction and 3 inches in the vertical direction. This gave a total of 6 feet of deformation in the horizontal direction and 7/12 foot of deformation in the vertical direction, aiding in the attenuation of the decelerative force. This resulted in approximately 13 g in the horizontal direction and 6 g in the vertical direction, with a resultant of 14.2 g at an angle of 25°. These levels of deceleration are within human tolerance and probably contributed to the fact that each individual remained in his seat. The levels are certainly in the range where major aircraft deformation would be expected . . ."

Accident 2:

With a pilot and technical observer aboard, a UH-1C was on a test flight after a PE. The pilot began a 180° turn at approximately 300 feet above the ground and started his recovery at about 100 feet by applying power. He flared to slow the rate of descent, intending to complete the maneuver at a hover. The helicopter continued to descend at a high rate until impact with the ground. It bounced back into the air, hit the ground again, and rolled on its right side. The accident investigation board determined that the cause of this accident was ". . . attempted power recovery from autorotation at too low an altitude to permit time for the engine to develop sufficient power to maintain rotor rpm. Loss of rotor rpm resulted in the aircraft striking the ground with impact forces far in excess of those it was designed to withstand."

Flight surgeon: ". . . The pilot was examined and questioned about one and one-half hours after the accident. There was no sign of injury and subsequent X-rays of the lumbosacral spine were normal. He wore a flight helmet, combat boots, fatigues, flight gloves, and sunglasses. He was restrained by his seat belt and shoulder harness.

"The pilot was not certain that he had fully opened the throttle as he had intended. . . .

"The technical observer was examined and questioned the morning after the accident. He claimed that he had hit his head against the seat armament several times but, due to the protection of his flight helmet, he had sustained no injury. There was no sign of injury and subsequent X-rays of the cervical and lumbosacral spine were normal. He wore fatigues, combat boots, and flight helmet. He was also restrained by his seat belt and shoulder harness.

"The miraculous lack of injuries to these two men is mainly attributable to the wearing of proper safety equipment and the absence of fire following the accident. If there had been a fire, there would probably have been serious injuries, as neither man wore any fire retardant clothing and one man [the technical observer] did not wear gloves.

"Metal ammunition belts, metal boxes, and debris were scattered throughout the rear of the aircraft. If any passengers had been present in the rear, serious injuries would have resulted. No debris reached the front of the aircraft. . . .

"There was no survival gear on the aircraft. . . .

"There was no evidence that fatigue, drugs, alcohol, or nutritional state were factors in any way.

"Recommendations:

"1. All items in aircraft (cargo) should be well secured before takeoff.

"2. Fire retardant clothing should be worn by all persons in aircraft.

"3. All persons in aircraft should be required to wear flight helmets, gloves, and seat belts as an absolute minimum.

"4. Authorized survival gear should be carried. . . ."

Accident 3:

A UH-1D, with an aircraft commander, pilot, crewchief, and two technical observer passengers aboard, was on a test flight to check for proper blade track. A final trim tab adjustment was made and the helicopter was brought to a hover where a left pedal turn was made and the takeoff started. As it went through translational lift, a loud crack or pop was heard coming from the aft section. This noise was caused by the loss of a tail rotor blade. The helicopter made a 180° turn to the right, assumed a nose-low attitude, and the main rotor blades struck the ground. The UH-1D bounced back, continued its turn to the right, hit the ground inverted, and rolled over on its left side. A small electrical fire which started in the engine section was quickly extinguished by maintenance personnel at the scene.

The accident investigation board determined that the retainer nut (P/N 204-010-711-1) had backed off from the tail rotor hub yoke, allowing the tail rotor blade and bearings to separate from the yoke assembly. The retainer nut on the opposite tail rotor hub yoke was found to have no torque and was free to wear on the two cotter pins installed as safeties. The tail rotor hub and opposite blade, along with the 90° gear box, were thrown from the helicopter due to the unbalanced condition caused by the loss of the blade. The loss of these components placed the helicopter in an uncontrollable flight configuration. It was undetermined whether inadequate torque or materiel failure caused the nut to back off. MWO 55-1500-200-30/35, incorporating a larger bearing retainer nut and two spool pins in lieu of the two cotter pins, as well as replacing the brass shims in the bearing stack with stainless steel shims, has since been issued.

Flight surgeon: "The pilot was completely restrained in his seat as the aircraft struck the ground on the top aft section of the fuselage and rolled on its left side, resulting in the collapse of the left door frame which caused a contusion on the pilot's left arm.

"The crewchief was restrained only by a safety belt. He was flexed forward sharply on impact and sustained a whiplash sprain of the paravertebral muscles in the L1-L5 region. Several abrasions at his waistline and flanks indicated that the safety belt was either worn too high or was loose. Securing the belt across the lap could have prevented this injury.

"One passenger was also restrained by a safety belt. Upon deceleration, he was flexed forward and struck in the back by a full ammunition box, causing a large contusion in the lumbosacral area. Emphasis must be placed on securing all loose items in aircraft before takeoff. . . .

UH-1 hit power line, which wrapped around mast and caused loss of control

"The other passenger was also restrained by a safety belt. Upon deceleration, he was flexed forward and struck his head against a sharp injury-producing object. It could not be determined just what aircraft structure he struck with his head, or whether he was hit in the head by a missile. It was determined that his fractured vertebra (fourth lumbar) was a compression fracture produced by the abrupt whiplash flexion. His seat belt was either too loose or worn too high. This was substantiated by abrasions of his flanks and high waist. The back injury could have been prevented if the seat belt had been secured tightly across the lap. In all probability, this passenger was struck in the head by a full box of M-60 ammunition. These aircraft carry about four boxes under the troop seats. These boxes are usually not secured and easily become free-flying missiles upon deceleration.

". . . Post-accident examination and interviews with both pilots ruled out any human cause factors. Both had sufficient rest the five days prior to the accident. Neither had been taking drugs; nor was there any history of drinking 24 hours prior to the crash. Their flight time during the 24 hours and 30 days prior to the accident was not excessive and the number of duty hours was well within the usual for the area. Fatigue was not a factor and both pilots were free from any psychological problems which could affect flying performance. Their home life was normal and their job performance was considered excellent by their supervisors. Both were experienced aviators. . . .

"The most serious injury was suffered by a passenger. It is believed that the comminuted fracture

Though both occupants escaped with minor injuries, crash was labeled nonsurvivable

Pilot and technical observer escaped injury because they wore protective equipment and were restrained by seat belts and shoulder harnesses

of his fourth lumbar vertebra was produced by the whiplash mechanism. He was wearing his belt either too high, too loose, or both. . . . He also suffered a 2½ inch laceration to the full thickness of his scalp. It appears that he was struck by a full box of M-60 ammunition which was not secured before flight. From the analysis of these injuries, it is recommended that the importance of securing the safety belt snugly across the lap, *not* the waist, be re-emphasized. Also, emphasis must be placed on securing all loose items in the aircraft which may act as missiles upon deceleration."

From the June 1967 U. S. Army Vietnam *Aviation Pamphlet:*

FLIGHT SURGEON BRIEF

Psychological factors: The aircraft commander and the pilot had disagreed the preceding day

about whether the pilot was ready to fly the UH-1C and about the tactical employment of the aircraft. It should be noted that the AC had been flying in this aviation platoon for two months and the pilot had only been in-country ten days with 30 minutes familiarization in a UH-1C the previous day with the same AC. The dissension was heightened by the pilot's insistence that he fly with the AC in the lead aircraft. During the first part of the mission, the AC related he questioned the pilot's actions and the pilot made many comments regarding the AC's utilization of the gun platoon. (The pilot had been a gunship instructor in CONUS and had flown gunships in the Republic of Vietnam on his previous tour here.) By 1400 hours on 7 February 1967, the pilot-aircraft commander relationship could be characterized as mutually hostile to an extent which compromised their efficiency. The intensity of feeling was partly predicated by the personality characteristics of the aviators. Both are tenacious, aggressive, and competent aviators.

Preflight factors: The pilot did not consciously lift the ship to a hover to check its torque, although he was not familiar with this ship. It was heavily loaded with fuel and ammo, and the density altitude was high.

Inflight factors: A drop in rpm to 6400 and the pilot's concern with this resulted in channelization of his attention to the engine gauges. At the same time, the aircraft commander turned his attention to his radios. As a consequence at impact, neither aviator was aware of the extreme low altitude of the ship. These deficiencies of awareness were the consequence of the aviators' emotional state and their inclination to ignore each other and devote themselves to a specific task; this at the expense of crew coordination.

Experience factors: The important contributing experience factors are two. First, the pilot had very little recent experience in this aircraft and very little briefing on company operational procedures. Second, neither aviator had specific training in the hazards of overwater flight.

Injury causation: No serious injuries were sustained by the survivors, and those that they did suffer probably occurred while escaping the sunken aircraft. The crewchief and gunner presumably drowned. They were both seen free of the ship but did not swim. They wore flak vests which weighted them down. Autopsy will probably reveal other injuries sustained on impact.

Conclusions: The important contributing causes are pilot-aircraft commander conflict and hostility, overconfidence, high load and high density altitude, lack of pilot experience in this aircraft, and lack of experience in overwater flight. These conditions led to the minor loss of rpm, focusing of the pilot's attention within the cockpit, and failure to recognize the nose-low loss of altitude.

Recommendations: The absolute necessity of maintaining emotional detachment and objectivity and accepting responsibility for the aircraft and the lives of its crew seems too obvious for re-emphasis. However, the demands of combat and the youth and relative inexperience of aviators has led to a situation in which these cardinal principles of flight are infrequently stressed and often violated. Commanders must emphasize the importance of meticulous attention to detail and detached professionalism.

This accident emphasizes the importance of thorough briefings and unit level training of recent arrivals, however extensive their experience. Firm, realistic, command guidance should be given, establishing training and familiarization requisites. Those directly responsible for mission assignment must assure themselves that an individual's level of competency and currency is adequate for the assigned mission.

Although it is not feasible to equip Army aircraft with sea survival gear, the environment of Vietnam increases the risk of ditching in water, and crews should be throughly trained in escaping a sunken aircraft and in shedding encumbering gear. In areas where frequent overwater flight can be anticipated, the feasibility of individual flotation gear should be investigated. Aviators in the Republic of Vietnam should be instructed on the adverse effects of overwater flight on the reliability of their depth perception and peripheral vision.

Pearl sells advantages of NOMEX flight clothes to Major Ronald H. Merritt, former CO of the 129th Assault Helicopter Company

pearls

personal equipment and rescue/survival lowdown

Past accident experience has proved that fire retardant clothing can be one of our most vital items of personal equipment. Writing in the May 1967 issue of the U. S. Army Vietnam AVIATION PAMPHLET, Major Anthony A. Bezreh, former USABAAR flight surgeon describes a case in point.

Latest Fashion Tips For The Well-Dressed Pilot

Major Anthony A. Bezreh, MC/FS
USARV Flight Surgeon

pearls

Latest Fashion Tips For The Well-Dressed Pilot

"TO BE, OR NOT TO BE. That is the question." Good old Willy Shakespeare may not have been thinking of Army aviators in Vietnam when he wrote that famous quote, but some recent experiences have indicated that he well might have. Let's take a case in point, a very recent hellacious combat accident that ought to make believers out of some of those hard heads that we still have floating around. Only the names have been changed to protect the innocent.

It seems that a couple of our buddies, good old Andy Aviator and Peter Pilot, were zipping along in a Huey at about 200 feet above the terrain when they suddenly learned — from the fact that 7.62 caliber rounds were smashing all over the place — that they were directly over an estimated two VC battalions who were zapping them with automatic weapons. Almost immediately the instrument panel started blazing, lapping the left side of the cockpit with flames.

That's where Peter Pilot was sitting all dressed up not to be killed, with a fire retardant NOMEX flight suit, one of those new jobbies that someone had given him to wear as part of a field test. Pete also had on his ballistic helmet with the visor down. He was wearing flight gloves with the ends tucked under his flight suit sleeves which, by the way, were not, I repeat were not, rolled up. And he had the collar of his flight suit turned up and tucked under his helmet.

Pete had been in an accident once before, and he was a believer. He knew that his personal protective equipment had to be used properly if it was going to do him any good. But, enough of this preaching; let's get back to the plot, which as you may have suspected, is going to thicken.

Andy Aviator was at the controls. He didn't know it yet, but there was a fire aft too. In fact, the whole tail section was engulfed in flames. Flames were lapping close to Crewchief Chuck and Door Gunner Dan from under the firewall, and the whole blasted compartment was filling up with smoke.

Andy knew that if he put the ship down in the middle of all those cottonpicking VC they all would have had it; so he "elected" to try to make it to an area about 1,100 meters away that looked a little safer. It took about a minute and a half to make

If you have a question about
personal equipment or rescue and survival gear,
write to Pearl, U. S. Army Board for Aviation Accident Research,
Fort Rucker, Alabama 36360

it there, and surprisingly enough he had power all the way. He was just setting down when at about 3 to 5 feet off the ground the airplane exploded, not just once but two times in close succession. By some miraculous process, the blasts actually cushioned the landing and demolished the aircraft all at the same time.

A lot of things were happening within a few seconds of each other. A round came in through the plexiglass, grazed Peter Pilot's shoulder, bounced off his seat, and impacted Crewchief Chuck's ballistic helmet just above the forehead. The round knocked Chuck back hard against the firewall, but it didn't hurt him or the helmet either, for that matter. Chuck knew that something had happened, but he still wasn't sure what.

It was shortly after this that the explosions threw Andy Aviator and Door Gunner Dan completely out of the chopper. Andy's shoulder harness and seat belt didn't hold him in his seat because they had both been melted away by the intense heat of the fire. So, if you have any doubts as to whether or not this was really a hot fire, there's your answer.

Crewchief Chuck jumped out under his own power, and only Peter Pilot remained in the flaming wreck. Poor Peter was pinned down by the gunsight and wreckage and couldn't get out. He spent another incredible 1½ minutes in that blazing inferno, trying to get out. During this time Door Gunner Dan, who also was wearing a NOMEX fire retardant flight suit, made two attempts to approach the flaming wreckage to pull Pete out. But both times he was forced away by the intense heat of the fire.

Somehow both NOMEX flight suits, Pete's and Dan's, got soaked with JP-4 fuel, but they didn't catch fire. It looked as if Peter Pilot had had it. The actual back cushion of his seat was in flames, and the nylon of his shoulder harness was completely melted and dripping down his flight suit. The nylon of the nape strap of his helmet melted away. Even the chin strap started sagging as its nylon started to melt. It was about at this point that Pete decided he probably ought to do something. Somehow, he managed to free himself and get out of that early grave. Shortly afterward, all four were picked up and taken to safety.

Now, get this. Pete had been sitting in flames and intense heat for possibly up to 3 minutes, but the only burns he ended up with were first degree and superficial second degree burns on his upper back and lower neck. These undoubtedly were due to the fire going on in the back cushion of his seat. But that NOMEX flight suit never caught fire. The heat from the flames was transmitted through the suit fabric to his skin and caused the burns. Pete can show you that flight suit today, and it is as good as new. And don't ask him to part with that flight suit either, because he just isn't about to. That suit saved his life and he knows it.

Unfortunately, Crewchief Chuck left his ballistic helmet at the scene of the wreck, and some VC probably has it by now. So if you see a VC someday wearing a ballistic helmet, don't bother shooting him in the head because it probably won't do any good.

The moral of this story is that it seems the day is finally arriving when we Peter Pilots, Andy Aviators, and all the rest are getting some protective equipment that can really make the critical difference. So, let's take advantage of the situation. Let's wear this stuff and wear it right. If you goof up, the life you lose may be your own.

LETTERS

Continued from page 1

of a combined combat team, the armed helicopter commander can only recommend. However, recommend he cannot or even employ his weapons to their best advantage unless he knows as much as, or more than, the ground commander about the ground battle.

MAJ GEORGE L. O'GRADY
Department of Tactics
Ft Rucker, Ala. 36360

Sir:

I would like to comment on the "Appeal to the Ladies" made in (Feb 67 issue) Aviation Digest. I feel eminently qualified to discuss the article since I am the wife of a Master Army Aviator; we have a 19 year old Warrant Officer Candidate in the family; and I am on active duty as a WAC captain assigned as Adjutant, Troop Command, USAPHC, Fort Wolters, Texas.

Army aviators are men, but this article implies that they are boys unable to take charge of their environment. The admonition to wives to feed the aviator properly, tuck him in bed at night, and worry about his weight encourages "momism" in young men and women. There is no place in the Army for a soldier who remains a mama's boy. When a flier is, quote, browbeaten, dominated, and much-married, unquote, he has not taken charge of his own situation and he blames his wife for his own weaknesses.

A logical question arises: how does the bachelor aviator survive?

In a professional aviation magazine it is unwise to take pot shots at wives who in reality do not have an obligation to *make* their husbands safe aviators. The professional flier must do this for himself. He is not a child and the wives club is by no means a PTA.

I agree that wives, mothers, and family can help the aviator but in the last analysis he is the HEAD OF THE HOUSE. A positive approach would be to emphasize to aviators (and other soldiers) the importance of "sharing" their job and experiences with wives. As a member of the military I have accompanied my husband on RON's, I've visited operations, and I occasionally have done some hangar flying at the airfield. These experiences and my assignment at the Primary Helicopter Center, plus many conversations at home, contribute to my knowledge of Army aviators and pride in my close association with Army aviation and my husband's accomplishments.

Not all wives can get first-hand insight into Army aviation as I have. But in a professional magazine let's accent the positive: tell aviators that *wives need to know*; tell them to share experiences; to plan off-duty time; but foremost, let's not encourage them to hide behind the skirts of wives!

CPT JANEEN C. MOREL
Headquarters Troop Command
U. S. Army Primary Helicopter Center
Fort Wolters, Texas 76067

• *We agree with CPT Morel that Army aviators must be men in the strongest sense of the word, whether they're old hands at marriage or bachelors. We also agree that married aviators should share their experiences with their wives when this is possible without breaching security regulations. We believe that happy and successful marriages are created only where there are full partnerships between husbands and wives.*

As full partners, wives have every right to expect that they will know *and* share *their husbands' experiences and careers to the fullest extent possible. To no less degree, they have an obligation to do all in their power to make their husbands' home lives as happy, healthy, and free of worries as possible, not to make "mama's boys" of them, but to provide an atmosphere in which strength, health, and ability will flourish. Two heads are truly better than one! —The Editors*

Sir:

I have had 2 years of field experience since graduating from the Safety Course at USC. It is evident that there is a real lack of understanding in knowing what is reportable and what is recordable.

Aviation commanders often shudder when their operations officers call them and say, "Sir, one of our ships has gone down." In a split second his mind is crammed with several questions. Was anyone hurt? Was the aircraft damaged? If it was damaged is it a major or minor accident? What reports have to be made and in what sequence?

A formulated plan in a time of stress can prevent confusion. What I offer here is what I have found to be the essential reports in chronological sequence.

You've just been notified an aircraft is down. What is reportable and what is recordable? A precautionary landing, forced landing, incident, missing aircraft, abandoned aircraft, minor accident and major accident are all reportable and a crash facts message is required. This message should be sent within 8 normal duty hours after the mishap has occurred — even if complete information is not readily available, send it. You have 5 working days in which to send a supplemental message, referencing the original, including date, aircraft type, and serial number.

Minor and major accidents are recordable and accident boards will be convened. Any damage in excess of $100.00 requires that a DA Form 285 be submitted with the exception of major and minor accidents where the information is available from the DA Form 2397. A DA Form 285 will *not* be prepared and submitted by boards of officers investigating an Army aircraft accident.

For a minor and major accident a complete DA Form 2397 series should be prepared and submitted to arrive at U. S. Army Board for Aviation Accident Research within 30 working days after the date of the accident. Aircraft missing over 24 hours and abandoned aircraft will be treated as a major accident.

Accidents which occur outside the continental United States should be mailed to arrive at USABAAR within 40 working days after the date of the accident.

Now if you are really interested in knowing *all* the procedures, I suggest you take a walk to your local AG reference file and check out AR 385-40 — it's free.

CW3 RICHARD C. KEEHN
Aviation Safety Officer
4th Armored Division
APO U. S. Forces 09326

• *In addition to AR 385-40, USABAAR recommends you include AR 385-10 and AR 95-5 for your pre-accident planning. Appendices I, IV, and V of AR 95-5 contain a crash plan guide that can be tailored to individual units, a sample crash facts message, and a checklist for aircraft accident reports. A local AG reference file may not always be readily available. However, these regulations should always be immediately available in every unit operating Army aircraft. —The Editors*

Sir:

Reference your article "What Are Your Intentions?" under the title "It Couldn't Happen To Me!"

On page 56, second column, third and fourth paragraphs, it is stated that the heater in the twin engine aircraft consumes 2 gallons per hour normal and a maximum flow of 3 gallons per hour. It appears that the writer of the article refers to the U-8F, since the picture on page 55 is the fuel selector panel of the U-8F.

The writer of this article uses these figures as fact and bases parts of the accident conclusions on this consumption.

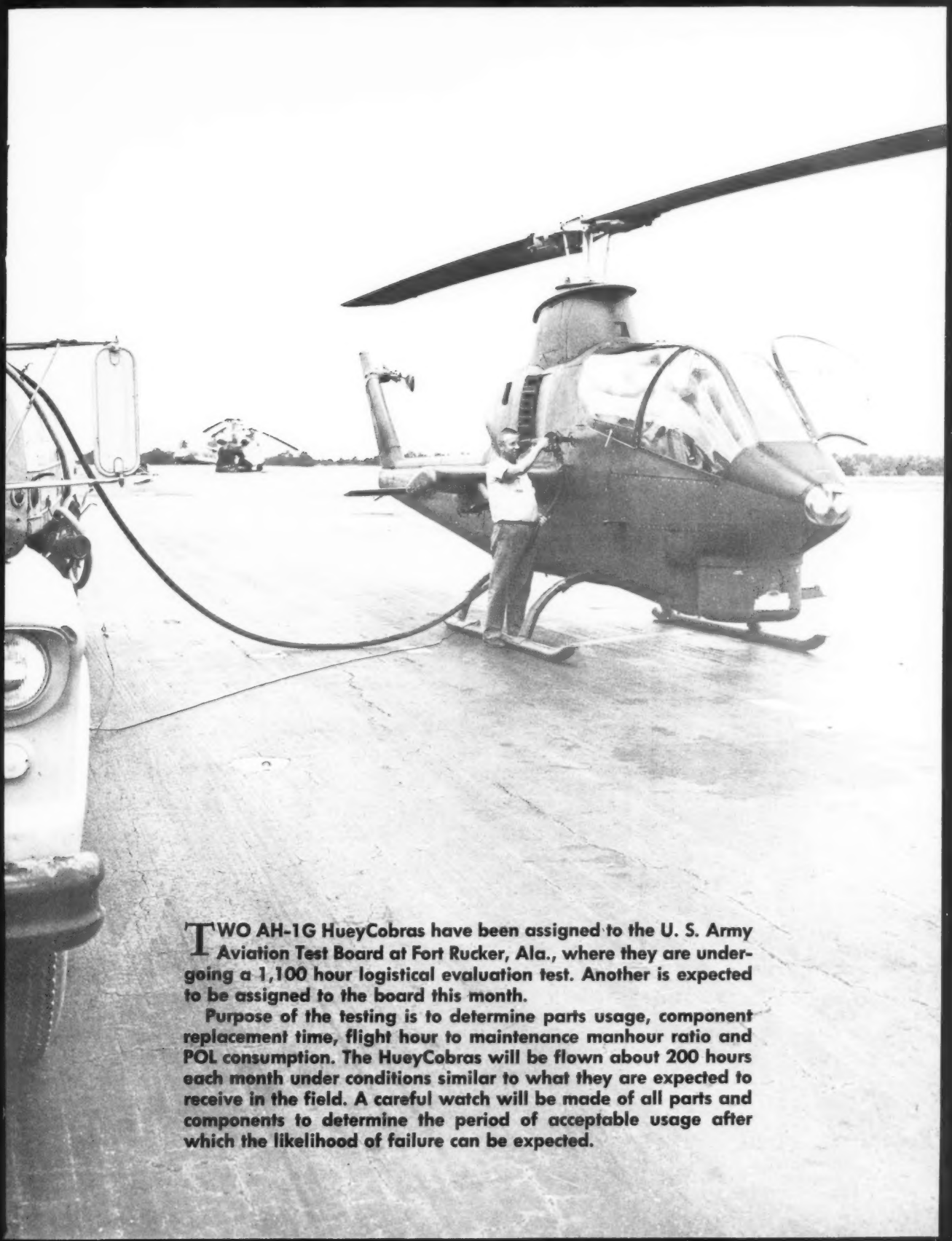
If this is true, the U-8 manual TM 55-1510-201-10 is incorrect and has been for 10 years.

Chapter 6, section II, para 6-4 states that "Fuel consumption is approximately ¼ to ½ gallon per hour."

If this fact is incorrect, I recommend an immediate change be published to the -10. If the -10 is correct, I recommend a correction be made to your article so that aviators are not to be confused.

MAJ CHARLES M. PAULK
937th Engineer Company (Aviation)
Ft Clayton, Canal Zone 09827

• *Though similar, the airplane involved in this accident was a leased civil airplane and not an Army U-8F. It had a Janitrol heater with a fixed flow rate of 3½ gallons per hour when in the cycling operation. It was estimated by the accident investigation board that the average fuel consumption for the flight involved was 2 gallons per hour for a total of 12 gallons.—The Editors*



TWO AH-1G HueyCobras have been assigned to the U. S. Army Aviation Test Board at Fort Rucker, Ala., where they are undergoing a 1,100 hour logistical evaluation test. Another is expected to be assigned to the board this month.

Purpose of the testing is to determine parts usage, component replacement time, flight hour to maintenance manhour ratio and POL consumption. The HueyCobras will be flown about 200 hours each month under conditions similar to what they are expected to receive in the field. A careful watch will be made of all parts and components to determine the period of acceptable usage after which the likelihood of failure can be expected.

The Flight Surgeon's Oath

I ACCEPT the sacred charge to assist in the healing of the mind as well as the body.

I will at all times remember my responsibility as a pioneer in the new and important field of aviation medicine. I will bear in mind that my studies are unending; my efforts ceaseless; that in the understanding and performance of my daily tasks may lie the future usefulness of countless airmen whose training has been difficult and whose value is immeasurable.

My obligation as a physician is to practice the medical art with uprightness and honor; my pledge as a soldier is devoted to Duty, Honor, Country.

I will be ingenious. I will find cures where there are none; I will call upon all the knowledge and skill at my command. I will be resourceful; I will, in the face of the direst emergency, strive to do the impossible.

What I learn by my experiences may influence the world, not only of today, but the air world of tomorrow which belongs to aviation. What I learn and practice may turn the tide of battle. It may send back to a peacetime world the future leaders of this country.

I will regard disease as the enemy; I will combat fatigue and discouragement as foes; I will keep the faith of the men entrusted to my care; I will keep the faith of the country which has singled me out, and with my God.

I do solemnly swear these things by the heavens in which men fly.